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IMPACTS OF AIR POLLUTION ON NATIONAL PARK UNITS

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HEARINGS

BEFORE THE

SUBCOMMITTEE ON
NATIONAL PARKS AND RECREATION

OF THE

COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS
HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

FIRST SESSION

ON

IMPACTS OF AIR POLLUTION ON NATIONAL PARK UNITS

HEARINGS HELD IN WASHINGTON, DC
MAY 20 AND 21, 1985

Serial No. 99-10

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IMPACTS OF AIR POLLUTION ON NATIONAL PARK UNITS

MONDAY, MAY 20, 1985

House of Representatives,
Subcommittee on National Parks and Recreation,
Committee on Interior and Insular Affairs,
Washington, DC.

The subcommittee met, pursuant to call, at 9:45 a.m., in room 1324, Longworth House Office Building, Hon. Bruce F. Vento (chairman of the subcommittee) presiding.

Mr. Vento. The Subcommittee on National Parks and Recreation will be in order.

Today and tomorrow we will hear testimony from witnesses regarding the effects of air pollution on natural and cultural resources of the national parks. The subcommittee schedule provides for public witnesses to testify today and for administration witnesses to testify tomorrow.

The administration witnesses will include several park superintendents and National Park Service research personnel who can tell us first hand what the effects of air pollution on national park units are.

We have all heard or read of the almost endless debates about various aspects of air quality standards. We are not investigating those issues, that is the quantifiable aspects of air quality, nor do I intend that the subcommittee necessarily debate them, although realistically I suppose it is difficult to avoid that.

The purpose of these hearings most importantly is to establish what effects air pollution is having or may be reasonably expected to have on the natural and cultural resources of our park system. We as a nation have over the last 100 years or so, extended great efforts to protect and preserve the best examples of our natural and cultural heritage within the umbrella of the National Park System. These decisions were not made lightly. We are surrounded by great controversy in the establishment of the first park, Yellowstone, which was bitterly fought by various interests.

Since then, almost all of the units added to the National Park System have been opposed by such interests. However, the desire of the people to protect our great heritage prevailed.

Today we face a problem that is different, now we find from the Adirondacks in the East to the Rockies in the West, the tops of these mountains are indicators of things that are going awry with respect to various plant and vegetation. The reasons we preserve these parks, the various qualities we try to preserve are indeed at great risk today. Parks that were set aside by our predecessors in this committee are facing air pollution problems. In some cases the very resources we thought were protected.

I have read the Congressional Research reports that you have before you, and have attended the briefing that the National Park Service gave for members and staff and I can tell you I am amazed at how widespread the effect of air pollution in the parks is. I am deeply concerned at the high level of vegetative damage already recorded from every region of the country, and wonder how it can get much worse, how fast it will occur, and what is causing the damage, and what we can do about it.

In addition, I am told that research carried out in Shenandoah, Great Smoky Mountains, Saguaro National Monument, and Indiana Dunes National Lakeshore have demonstrated that leaf injury and other adverse biological effects to other vegetation are occurring from ozone and sulfur dioxide at high concentration although they do not exceed national ambient air quality standards established by EPA for these pollutants.

If this is true and I request the appropriate witnesses comment on this, I am very concerned that the currently established standards are not set at concentrations that do indeed protect important native vegetation resources of our park units, or of the National Park System.

We have many witnesses today but again, I want to underline the importance of this has a look in reality, not at the quantified results of what the standards are, but to look at what the effect is at the ground level, what is happening to our national parks, very often in terms of visibility. The lichens and the other indicator plants, which are sensitive to a variety of different pollutants, all are showing and giving us a roadmap that indicates substantial damage is occurring in our national parks.

The idea is to pull up our bootstraps to do the job and prevent that from occurring. We know the damage is significant, we know that very often the damage that is occurring can be corrected and must be addressed if indeed we are going to maintain parks for the qualities for which they were established.

That of course is very much in question today with regards to the dry deposition of various pollutants, even being able to see these. So it is a very serious problem.

I am very pleased with the response, incidentally, to date of the private sector in terms of the work that they have done and their willingness to come forth and spend the day examining these issues with the subcommittee, and so far with the administration their willingness to bring in park superintendents and others who have firsthand experience in dealing with the air quality deposition programs, for instance, working in conjunction with Canada and many others.

I would call upon my ranking minority member, Mr. Lagomarsino, for an opening statement.

Mr. **Lagomarsino**. Thank you very much, Mr. Chairman.

I would like to commend you for holding these hearings to bring attention to what I believe we all agree is a concern, air quality in the national parks.

Although it appears that the bulk of the research conducted so far seems to indicate that our national parks have not yet been significantly damaged, there is no doubt the parks are very sensitive areas and probably extremely vulnerable to air pollution. As the chairman pointed out, one of the points in setting up the parks in the first place was to preserve them in their pristine quality. It is something that we should be very concerned about so I am pleased that the committee is attempting to compile what I hope will be a very factual and complete record on this important issue.

Furthermore, you agree on the importance of examining the air pollution-acid rain issue at this time to determine whether additional action is necessary to preclude serious air degradation within our national parks.

Mr. VENTO. I thank the gentleman for his presence and his statement.

The gentleman from Georgia, do you have an opening statement?

Mr. DARDEN. No, Mr. Chairman. Thank you.

Mr. VENTO. We are pleased to have you here, Mr. Darden, and look forward to your participation in the hearings.

The gentleman from Utah.

Mr. HANSEN. Thank you, Mr. Chairman, I appreciate being here today. I appreciate you calling this hearing. I hope we are able to work this out.

Through the process of reapportionment I guess I represented all the areas of Utah except possibly that little city called Salt Lake and have had the opportunity of being in those parks and in the national monuments. We probably have 13 parks and national monuments in the area I have represented.

As I see it I agree with the problems you brought up and I believe it is important to remember that the same geological process which created our beautiful national parks also created the numerous valuable natural resources we use daily in our society.

I would hope as we go through this that we can see this balance we are always trying to work at with the idea of what can be developed and what should be preserved.

I can see no reason why these cannot go hand in hand. I guess this is one of the things we are here to ferret out and find out how it works so there is no degradation to the parks. I commend the chairman for looking at it in that light.

I hope the witnesses keep in mind that there is more than just their own interests at heart, there is a big world out there and a lot of people involved. As I look at Utah, there are those who want to tie up the parks so no one can even look at them but they are the most beautiful on Earth. The Lord created these things, or however you want to say they are created, they are absolutely gorgeous and I worry about those who don't want anyone to even see them.

That is the reason we have parks.

So I would hope as we look at this today that we find ourselves in a condition that——

Mr. VENTO. Would the gentleman yield?

Mr. HANSEN [continuing]. I would be happy to yield.

Mr. VENTO. I think that is exactly the point. I think the gentleman should pay close attention to the issue of visibility, because a lot of the parks are basically shrouded now in clouds of gas, clouds of pollution that really prevent that from occurring. We will be examining that and the visibility issue is a very, very important one. Of course it is the manmade pollutants that are indeed challenging the opportunity to enjoy these great vistas and surprisingly Utah with its tremendous contribution to the National Park System in terms of numbers of areas and quality, is one of those areas that is adversely affected.

So I am especially pleased that the gentleman has taken time out on a Monday morning to be here with us.

Mr. **Hansen**. I thank the chairman. I yield the time back to the chairman.

Mr. **Vento**. If there are no other statements, it is a pleasure to welcome Senator Jim Sasser to the committee from Tennessee. Senator Sasser and I began our service in Congress in 1977. He has an impressive record of service to the people of Tennessee, and is an outspoken advocate on environmental issues.

Senator, it is a pleasure to welcome you here. We look forward to your opening our hearings and we look forward to your comments with respect to air pollution in the national parks and public lands areas.

[Prepared statement of Hon. Jim Sasser may be found in app. I.]

STATEMENT OF HON. JIM SASSER, A U.S. SENATOR FROM THE STATE OF TENNESSEE

Mr. **Sasser**. Mr. Chairman, and members of the committee, I am grateful to you this morning to have this opportunity to appear before you and I might say that my testimony includes materials from various sources, they are completely listed in the conclusion.

In the interest of brevity, Mr. Chairman, I would like this morning to summarize my statement to some extent and have the entire statement included in the record.

Mr. **Vento**. Yes; I would just comment that our policy of the committee is to provide each witness with 5 minutes and the complete statement, of course, will be made part of the record for every witness without objection.

Senator, you may proceed to summarize.

Mr. **Sasser**. Thank you, Mr. Chairman.

Acid rain is a highly complex and diffuse topic. It is a national problem, and the degradation of forests and streams, whether they be in California, Vermont, or Tennessee, I think is of concern to all Americans.

A concerted Federal-State-local response is necessary to tackle this problem.

The debate is ongoing regarding the cause or causes of acid rain. The most common culprits are thought to be sulfur and nitrogen oxides. Whatever the cause of acid rain, we see the devastating effects throughout this Nation. In particular, the southern Appalachian region has been identified as an area that is increasingly vulnerable to the slow and steady dangers of acid rain.

I am particularly concerned about the impact of acid rain on the Great Smoky Mountains National Park in my State. The Great

Smoky Mountains National Park is the most visited national park in the country. Each year 8 million visitors come into that park. It is an international biosphere reserve, boasting an ecological diversity that is unrivaled anywhere, for example, on the continent of Europe.

In addition, the Smoky Mountains is a world heritage park, one of only four world properties so designated.

Mr. Chairman, I am proud of the beauty and accomplishments of the Great Smoky Mountains National Park. For many years, I have sought wilderness designation for this great national resource and I expect to continue my efforts in that regard. By law, the Great Smoky Mountains have been designated as a class 1 air shed and presumably the Great Smoky National Park should be immune from significant amounts of air quality deterioration.

Yet, in fact, this great national park is presently threatened by slow and silent danger known as acid rain. Acid rain in the Smokies poses a number of problems, not the least of which is decreased visibility. Visibility impairment is most noticeable during the tourist-intensive summer months at higher elevation. The acid rainfall or acidity of rainfall in the park is 4.3 pH, the same pH as throughout the Tennessee Valley. But this is 20 times more acid than so-called normal rainfall with a pH of 5.6.

Since rainfall in the Smokies is 1.5 times that in the rest of the Tennessee Valley the disposition of acids there is probably greater than in the rest of the Nation. Streams at higher elevation in the Great Smokies experience an increase in acidity after storms, approximately 50,000 fish died at the Blankenship trout farm on Raven Fork Creek. The fishkills occurred during rains of 1 inch or more and that clearly indicates that heavy rainfalls increase the acidity.

Investigation later indicated that rainfall collected near Raven Creek was acidic ranging from 4.1 to 4.6.

The Great Smoky Mountains, while biologically diverse, is also ecologically fragile resource. Soils in the park are thin, thus less capable of buffering acidic concentrations of pollutants.

There is evidence that increased acidity in soils has adversely affected the red spruce. The red spruce is a long-lived shade tolerant species that is a major component of high elevation forests. There has been a rapid decline in this beautiful tree in the Smokies since 1970. As many as 60 percent of the red spruce at higher elevations may be affected.

Acid rain in the Great Smoky Mountains poses economic as well as environmental concerns. The Great Smoky Mountains, as I said earlier, is the most visited park in the National Park System. Sevier County alone had more than 8,000 tourist-related jobs created as a result of visits to the Great Smoky Mountains Park. The problems posed by acid rain are many. The solutions forthcoming so far have been few. Let me say I am encouraged by the leadership that the Tennessee Valley Authority has taken in combating the growing acid rain problem. The TVA, by its own admission, has been one of the Nation's largest emitters of sulfur dioxides. Yet, unlike so many others responsible for similar emissions, the TVA stood up and took its responsibility to the region and to the Nation.

TVA is a leader in this Nation's effort to upgrade environmental quality. In the past 6 years, TVA cut SO_2 emissions by 56 percent, from 2.3 million to 1 million tons per year. Particulate emissions have been cut by 100,000 tons or by over 90 percent. This is not done without cost.

TVA investment to date approaches $1 billion and this investment has been made by the electrical ratepayers of the Tennessee Valley area. Environmental neglect, Mr. Chairman, as you and the members of this distinguished committee well know, cannot be corrected overnight. Yet it is incumbent upon us to begin to reverse the damages caused by acid rain.

Acid rain will not disappear in its own accord. We must continue to raise the level of our thinking about solutions to the acid rain problem.

In summation, Mr. Chairman, I would say that the problem of acid rain looms ominously over the Great Smoky Mountains National Park, and indeed over this whole Nation.

I look forward to working with you and the other members of this distinguished committee and with my colleagues in the other body to put into place an effective acid rain mitigation program.

I thank you for the opportunity to appear here this morning.

Mr. **Vento**. We are very pleased, Senator Sasser, as one of the strong leaders on air pollution issues with Senator Mitchell and Senator Stafford that you took time to be here this morning and to I think put your finger on exactly what the concerns are.

I, like you, am proud of what the TVA has done to try to mitigate this. I notice you point out the costs. One of the concerns, of course, is that the other costs, the cost of not doing the activity, is one that is reflected in the red spruce that have been damaged in the Smokies, and that is indicated in terms of those trout losses and in terms of tourist dollars.

In reviewing this, Senator Sasser, are you aware of any compilation of those types of losses expressed in economic dollars there at this time? Are you aware of any economic dollar expression quantifying what those losses are? What is the effect, for example, we talk about the Great Smokies having a blue haze over them, I guess. What type of haze do they have these days under these circumstances, that have an effect on visibility?

Mr. **Sasser**. Visibility has been adversely affected by acid rain. Foliage and fauna have been destroyed. We think it was destroyed by acid rain. I alluded in my testimony to fishkills that have occurred in the Great Smoky Mountains National Park. As I stated, Mr. Chairman, this park is the most visited in the Nation, 8 million tourists come through it every year, tourists not just from the United States and Canada, but indeed from all over the world.

It generates an enormous amount of dollars just from tourists and from the tourist trade. In my State of Tennessee, tourism has—we have the second generation, second largest payroll and it is the second largest State taxpayer and the Great Smoky Mountains National Park has a very significant tourist attraction which generates a significant amount of these tourist dollars.

So in short, if we allow this park to continue to deteriorate as a result of acid rain, there is going to be very substantial economic loss to this region, and I think a very substantial economic loss to the Nation.

Mr. **Vento**. I notice, Senator, we are quick to put $1 billion cost on TVA's activity but we are trying to put billion dollar losses on the damages. If you lose $1 million tourists that would be $1 billion loss for the region, wouldn't it?

Mr. **Sasser**. Yes, Mr. Chairman, those figures are available and I would like to furnish for the record if I may a compilation of just how significant the loss of these tourist dollars would be in the event the Great Smoky Mountains ceases to become a tourist attraction.

[Editor's note.—The information relating to loss of tourist dollars may be found in app. I, following Mr. Sasser's prepared statement. See table of contents for page number.]

Mr. **Vento**. Our mandate, in terms of creation of this park and of this section concerning our wilderness, is to preserve it in perpetuity and obviously your concerns this morning suggest that that may not be being done under existing circumstances; even though TVA is doing their jobs, somebody else may not be, is that right?

Mr. **Sasser**. That is correct.

Even though TVA has spent very substantial sums to correct the problem of emissions coming from their power-generating facilities, this park is still being very adversely affected by pollutants coming in from other areas.

Mr. **Vento**. Maybe even from different countries.

Mr. **Sasser**. Perhaps.

Mr. **Vento**. The point is that—maybe it is all within legal limits, but the end effect, however, is the same. The air pollution being introduced is damaging the park in substantive ways irrespective of whether it is legal or not. We ought to avoid that. We have conflicting mandates here if that is the case, don't you agree?

Mr. **Sasser**. I agree with you, Mr. Chairman, as you so ably point out it makes no difference where the pollutants come from, whether they come from somewhere in the Midwest, or somewhere south of the border, or wherever. If they end up in the Great Smoky Mountains National Park, there their deadly damage is done.

Mr. **Vento**. The gentleman from California, Mr. Lagomarsino.

Mr. **Lagomarsino**. Thank you.

Was a study made, Senator, on the killed fish at the Blankenship trout farm to determine what killed them?

Mr. **Sasser**. Yes, an extensive study was made and as I understand it, a determination was made that they were killed as a result of excessive acidity in the water.

[Editor's note.—Additional information pertaining to the Blankenship trout farm may be found in appendix I, document entitled "Investigations of the Cause of Fishkills in Fish-Rearing Facilities in Raven Fork Watershed." See table of contents for page number.]

Mr. **Lagomarsino**. That was determined at the time?

Mr. **Sasser**. That is my understanding, yes, sir.

Mr. **Lagomarsino**. You talk about the TVA spending $1 billion to improve its pollution control devices. Was that something required by the Clean Air Act or local legislation or was it just something they thought that would be appropriate to do?

Mr. **Sasser**. Well, it was partially required by the Clean Air Act but the Tennessee Valley Authority went beyond just the requirement of the Clean Air Act and the gases presently being emitted from the stacks of TVA's coal-fired generating plants are even cleaner than required by the Clean Air Act, and this was done after a study by the TVA, in an effort to try to alleviate some of the conditions in the Tennessee Valley area to clean up the air as much as possible.

But as much as anything else to set an example for the rest of the Nation.

As I say, this bill was footed by the ratepayers of the TVA area on their electric bills every month.

Mr. **Lagomarsino**. Where does TVA get the coal that it burns?

Mr. **Sasser**. It comes from various and sundry sources, it burns a substantial amount of Kentucky coal, a substantial amount of West Virignia coal, and in recent years there has been an influx of Western coal. But it is essentially a mix of coals from the Appalachian region itself. They are relatively high sulfur coals.

Mr. **Lagomarsino**. If we had to have one simple solution, couldn't we solve a lot of problem by burning more Western coal and less Eastern coal?

Mr. **Sasser**. Well, we in the Appalachian region like to——

Mr. **Lagomarsino**. If you are really interested in reducing air pollution?

Mr. **Sasser** [continuing]. Use the coal from back home. That is one reason TVA went to the great expense of putting these emission controls on their stacks.

Mr. **Lagomarsino**. Would you say that again, I think it is very significant and I missed the first part of your last statement.

Why they did it? You said it was one of the reasons they did it.

Mr. **Sasser**. I think one of the reasons it was done was so they could continue to utilize coal resources from the Appalachian region. But the overriding consideration was to comply with not just the letter of the Clean Air Act but to comply with the spirit of it.

In that spirit, why, TVA went forward and cleaned up the pollutants coming out of their stacks considerably beyond what was required by the Clean Air Act.

Mr. **Lagomarsino**. Thank you, sir.

Mr. **Sasser**. Thank you very much.

Mr. **Vento**. I would just point out that there is clean coal burning technology that is available that can do the job in terms of this, but the investment is substantial and hence the billion dollar investment that TVA has made. They have been leaders under Mr. Freeman in the past to accomplish that.

The gentleman from Georgia, Mr. Darden.

Mr. **Darden**. Thank you, Mr. Chairman.

Senator, as your neighbor to the south, I want to express my appreciation for your being here this morning and for your commitment to this very significant and substantial problem.

I might say on a personal note that the first time I left the State of Georgia was to go to the State of Tennessee as a small boy to the Great Smoky Mountains to attend the Cherokee North Carolina celebration. I have a strong interest in this area. I was very concerned recently to learn that the TVA has abandoned its plans to build several nuclear plants now and will apparently continue to use coal as a primary source for its power.

Do you anticipate that the nuclear plants might be again utilized in an effort to reduce the sulfur emissions of the TVA?

Mr. **Sasser**. At some later date TVA quite possibly could go back and construct additional nuclear powerplants. As you know, TVA had the most ambitious nuclear powerplant building program in the world and constructed a substantial number of nuclear powerplants but because of decreased electrical demands in the Tennessee Valley area and because of the mushroominig cost of the nuclear powerplants, they cut back, but a couple of them have been mothballed in various stages of construction and at a later date they could be finished and activated.

Mr. **Darden**. Also, let me say I think we have perhaps unfairly focused on TVA as the principal source of these emissions. Could you identify some other potential emitters in the area that might have contributed to this problem?

Mr. **Sasser**. Well, I would be loathe to try to put my finger who the other culprits might be. It is difficult sometimes to tell.

As you well know, some of the emissions may come from automobiles, emissions from other power generating facilities in the region, and air currents bringing pollutants in from other areas of the United States.

I simply pointed out the efforts of TVA to fully comply, in fact more than fully comply with the Clean Air Act as evidence that we in the Tennessee Valley area are willing to, not only willing but eager to do our bit in cleaning, having clean air in the region and indeed are willing to pay the cost because we feel that the front-end cost of clean air in the long run is really cost-efficient and the most economical way to deal with this problem.

Mr. **Darden**. In fact, the automobile traffic during the summer months is many times bumper to bumper through the park, isn't it in certain areas?

Mr. **Sasser**. Yes, it is, many times it is bumper to bumper through the park.

Mr. **Darden**. Thank you very much, Senator.

Thank you, Mr. Chairman.

Mr. **Vento**. The gentleman from Utah, Mr. Hansen.

Mr. **Hansen**. Thank you, Mr. Chairman.

Senator, I appreciate your comments and applaud you for the work you are doing in this important area you have in your State.

Have you identified the source of the pollutants? You mentioned TVA has been able to do something. Have you pinned down any of these direct sources at all?

Senator **Sasser**. I think——

Mr. **Hansen**. It is pretty vague, where all this is coming from. Do you have any specific place you can say here is one that is hurting the Great Smokies?

Mr. **Sasser** [continuing]. I know that we have a problem. We have a very serious problem in the Great Smoky Mountains National Park. I know that if it continues to deteriorate at its present rate, that my children's children I suspect are not going to be able to enjoy that park in its full beauty as we have it today.

Now, I would be delighted to, for the record, undertake an investigation and furnish what we believe in the Tennessee Valley area might be the chief sources of pollutants.

[EDITOR'S NOTE.—Additional information pertaining to the pollution in the Great Smoky Mountains National Park may be found in app. I, newspaper article entitled "TVA knew plant was killing trees, engineer says." See table of contents for page number.]

Mr. **HANSEN**. It would be true the closer to the park the greater the possibility of pollutant would be? I am sure high atmospheric winds could pick up things from a great distance but in a general statement, I understand you are the leading authority of the State legislature there, would it be true the closer the source, the more pollutants you would have?

Mr. **SASSER**. I appreciate the accolade of being the leading authority. I would have to plead innocent to that. I don't hold myself out as the leading authority in this area at all.

We find that the pollutant level in the Great Smoky Mountains National Park is higher than it is in adjacent territory.

Mr. **HANSEN**. You said that tourism was possibly your second largest form of revenue, is that correct?

Mr. **SASSER**. It is the second largest payroll in our State.

Mr. **HANSEN**. And have you noticed that the problem you have articulated today has caused a cutback in the amount of tourism you have in the park?

Mr. **SASSER**. Not to date, but we would anticipate if damage continues to the park, that at some time in the not overly distant future it would become less of a tourist attraction.

Mr. **HANSEN**. I would assume that your businesses and others feel very strongly about the issue of tourism in your State, would that be a correct statement? I am only saying that because I come from a State that feels basically the same way. Maybe we should take a leaf out of your book to show how we can bring more tourism to southern Utah.

We are having a little more difficult time than you, if your park is the one with the most visitors.

Mr. **SASSER**. We are fortunate, I might say, Mr. Hansen, in that we are directly on the route from the Northeast and Midwest down to Florida. So if you are going south, it makes sense to stop in the Great Smoky Mountains National Park. We are fortunate in our geographical location.

Mr. **HANSEN**. I would say somewhat tongue-in-cheek that you may want to tell your businesses to burn more Western coal out there and you may solve that. We happen to be one of the largest producers of Western coal in Utah.

Mr. **SASSER**. Could you give us a substantial discount on that Western coal?

Mr. **HANSEN**. We already are, I believe. We would like to have you install a coal slurry line, that may make it easier.

Thank you, Mr. Chairman.

Mr. **VENTO**. The gentleman yields back the balance of his time. I would point out the Senator has been asked to come forth and talk about damages in his park. I think there is a tendency to want to point the finger at whatever, but the point is we are trying to look at what is the effect on the Great Smokies, what is the effect on the Grand Canyon, what is the effect on the parks throughout the country with respect to that.

That is why I say in defense of the Senator, that is why we are asking him to come here.

The gentleman from Ohio, Mr. Seilberling, chairman of the Public Lands Subcommittee.

Mr. SEIBERLING. Thank you very much, Mr. Chairman.

I would like to commend you for this excellent set of hearings on an extremely important subject and I certainly am impressed, Senator, by the scope of your knowledge and the balance in your judgment on this matter.

Of course the Great Smokies is one of our great national treasures. I have enjoyed visiting it myself. We hope that it will be something for all future generations to enjoy along with all the other great parks of our National Park System.

A couple years ago the National Parks Subcommittee held hearings on the state of the parks as reported in the 1980 report that was produced by the Park Service at the request of this committee. One of the things that was brought out in that report was that half of all of the threats to the resources in our national parks emanated from outside the parks themselves—air pollution, water pollution, et cetera.

Going around the country looking at our parks, Glacier National Park, Great Smokies, and others, in some cases you can see the visual results of some of the more extreme forms of air pollution; Glacier is a good example.

So this is not an academic subject. The interesting thing to me is that, thinking about this problem, that it doesn't just affect the parks of course. As you pointed out, there is a lot of timber harvested in the Great Smokies, North Carolina, Georgia, and I assume in Tennessee as well.

This is an economic resource which is being jeopardized. The same is true in Ohio, and Pennsylvania and other parts of the country, and just bringing it down to the individual, eventually one starts to realize that the trees in his own yard are threatened and the beauty of the forest that surrounds many of our homes is not something that is guaranteed to last forever.

So I think this just has tremendous ramifications.

Over the weekend I was reading some reports about air pollution in the Rocky Mountain area. While we think of the West as having alkaline soils, the higher elevations of course do not by and large. And air pollution is already passed the threshold of danger for fish resources in many of our Rocky Mountain—in fact all the Rocky Mountain States, and the problem is going to become more severe as smelters in Mexico come into production starting this year.

The importance of this I think is to dramatize for the people of my State of Ohio and other parts of the country that this is a problem which we cannot duck. The only question is how we pay for it.

While TVA has led the way we have to recognize that it is a national problem, it seems to me, and the Nation as a whole should help foot the bill at least certainly the consumers of the coal-fired electricity.

Would you care to express a view on that, Senator?

Mr. SASSER. Mr. Seiberling, you are asking me to step into a very tangled thicket there, but I can only say that air pollution is a threat, a significant threat as you have underlined in your statement.

We, in the Tennessee Valley area, felt it was a significant enough threat to ecological balance and to our economy that the Tennessee Valley Authority went forward and took the necessary steps at very substantial expense to try to alleviate the condition and to make sure that the TVA was in full compliance with the Clean Air Act.

Now, as we say in my neck of the woods, we bellied up to that buzzsaw and I think at some juncture that is going to have to happen in other areas of this country, and I think in other areas of the world if we are going to make substantial progress in dealing with the problem of air pollutants.

I think certainly the learned members of this distinguished committee know better than I the long-term threat of air pollutants.

Mr. SEIBERLING. Well, thank you. I attended an international conference under the auspices of the Interparliamentary Union in Nairobi, Kenya, in November of last year and it certainly brought home to me that this is not a problem limited to the United States or even North America, it is a problem that is worldwide, particularly acute in Western Europe, and it is becoming a problem even in areas that we don't think of as highly industrialized like some of the tropical countries.

Mr. SASSER. I might say for those of your colleagues who have been to Taiwan or some of the other rapidly industrializing areas on the rim of the Pacific, there you find some of the worse air pollution in the world. You can hardly breathe in some areas, as a matter of fact.

Mr. SEIBERLING. The cumulative effect of man's activity is something we have not reckoned with much in the past. We cannot escape it any longer. I think your testimony is cogent toward that end. Thank you. Thank you very much.

Mr. VENTO. The time of the gentleman has expired.

I think the gentleman's comments with respect to mountains and the areas we traditionally think the higher you go the better the environment, the more pristine it is going to be, is exactly right. Yet these areas that should be the most pristine of all are the first to be damaged and damaged most severely with respect to this.

You look at Germany and other areas, you find you have 50 percent damage in terms of the Black Forest and that is some indication of the economic impact that this portends unless we address this particular issue. As I said, contradiction exists between perpetuity and preservation on one hand, yet we have the substantial damage we hear about in the Great Smokies and I am sure we will hear about in other areas.

Mr. SASSER. Would the gentleman yield?

Mr. VENTO. I would be happy to yield.

Mr. SASSER. I would like to point out the parks are contributing a tremendous service as are the wilderness areas, because they are areas we can monitor as benchmarks to measure what is happening to our environment. This hearing is contributing to public understanding of their value to that end. Thank you.

Mr. **Vento**. I am privileged to have here the chairman of the full committee, the Honorable Morris Udall from Arizona.

Mr. Chairman.

The **Chairman**. Thank you, Mr. Chairman. I commend you for these hearings. They are timely and important. I want to associate myself with the remarks that Congressman Seiberling made and I wanted to congratulate you in carrying on the great tradition that he set, and Phil Burton before him, of really getting down to basic national conservation issues in this subcommittee, and I look forward to this hearing, and the one tomorrow, and I am delighted to have Senator Sasser here today as the "conservationist" in the best sense of that word, and we appreciate his counsel and advice.

Somebody wrote a book not too long ago entitled "No Final Victories." If there is one thing I have learned around here in the conservation issues in America, there are no final victories. With the leadership of the people like yourself and Congressman Seiberling we have got the best National Park System in the world. We set aside all of these crown jewels, and we protect them from all kinds of dangers, and we set aside wilderness areas. Congressman Seiberling has played such a major role in those. But we find we maybe haven't protected anything, that the high mountain lakes in the Rocky Mountains will die, and the trout streams in Utah, Colorado, and Arizona may not survive this acid rain problem.

Here is this crazy poison creeping across the country and we don't know quite what to do about it. It has ramifications for every section of this country. That is why I think these hearings are so important. It teaches us I think that everything is related.

I was with a bunch of people in the nuclear power industry the other day. They are beginning to think that nuclear power may come back and they think what will bring it back is acid rain. If the Nation is forced to confront the risks, and dangers and damages from acid rain increasing as it now appears possible, maybe the danger from nuclear powerplants doesn't appear to be quite as great relatively as some might have thought.

I don't necessarily endorse this but it is an indication of the difficulty and importance of this subject.

Mr. Chairman, I will follow these hearings with interest and I am delighted that you have begun them.

Mr. **Vento**. I thank the chairman for his participation.

I want to thank the Senator for being so generous with his time this morning, and for opening up our hearings in such a splendid fashion. Thank you.

Mr. **Sasser**. Thank you very much, Mr. Chairman. It is a pleasure to appear before you and your colleagues. You are doing magnificent work and when one appears here, one certainly ought to do one's homework.

Thank you.

Mr. **Vento**. I thank the gentleman.

Mr. **Darden**. You obviously have, Senator.

Mr. **Vento**. We now welcome Dr. Mohamed El-Ashry. We have a wealth of reports on the Adirondacks, the Great Smokies, the boundary waters, Indiana Dunes, and other areas, but one of the segments and one of the pieces that had not been in existence was the effect of air pollution in the great Western regions where so many of our national parks and important public resources exist, and important people exist, many of them being on this committee.

So, I am very pleased, I might say, that World Research Institute, under your leadership, Doctor, has indeed completed that void in the mosaic of information that is necessary for us to develop proper policies and to understand the impact on our national parks, public land, and economic resources in the West.

I might say that your report was a catalyst that motivated me and I think motivated participation in these hearings. I want to commend you again, the World Research Institute, for doing that tremendous work that I am sure will be very helpful.

Your entire statement, Doctor, will be made part the record, but certainly you may summarize.

[Prepared statement of Dr. Mohamed El-Ashry may be found in app. I.]

STATEMENT OF DR. MOHAMED EL-ASHRY, SENIOR ASSOCIATE, WORLD RESOURCES INSTITUTE

Mr. El-Ashry. Thank you very much for your very kind remarks. I am very pleased to appear before you today to address that critically important topic of air pollution in our national parks. For the record, my name is Mohamed El-Ashry. I am senior associate with the WRI and, prior to joining WRI, I was director of environmental quality for the Tennessee Valley Authority that Mr. Sasser spoke quite a bit about.

Prof. John Hart of the University of California at Berkley, and I have prepared a short statement which we submit for the record, together with a copy of the World Resources Institute's recent study of acid rain in the West that the chairman has referred to. Two conclusions from our study merit special consideration by this subcommittee, and I will highlight them briefly for you.

We have identified both a vulnerability and an opportunity that we believe deserve special attention. First, the qualities that make the American West and its vast national parks so valuable to us are precisely the qualities that make them so vulnerable to air pollution in general and acidic deposition in particular; second, by recognizing now the relationship between acidic deposition and the sensitive areas in our irreversible damage to these natural treasures before it occurs.

First, let me address the vulnerability question. Our review of existing scientific literature has convinced us that the mountain ranges of the West, which are the dramatic feature of so many national parks in the region, are more susceptible to damage than are the ecosystems in the East.

For example, mountains are higher and steeper in the West, and they have a thinner soil cover. This means that when acidic deposition falls on these mountains the acidic runoff can flow into the lakes and streams with little or no neutralization by the soils. Also, Western mountains tend to accumulate more snow than do those in the East, and during the spring melt this can cause a brief pulse of acidity to the surrounding bodies of water. This pulse, coming as it does when ecosystems are just beginning to grow with the spring, can place both plant and animal species at risk at a critical time in their development.

The problem of acid pulses is further complicated by the fact that many lakes in the West have low alkalinity, the property necessary to neutralize acidic deposition. This is especially true in many lakes in the Washington Cascades, the Sierra Nevadas, and the Rockies.

As you can see on the attached map, 10 national parks and 1 national monument are in areas identified as sensitive to acidic deposition: in the Cascade Range, Mount Rainier, North Cascades, and Crater Lake National Parks; in the Coast Range, Olympic National Park; in the Sierra Nevadas, Yosemite, Sequoia, and King's Canyon National Parks and Devil's Postpile National Monument; in the Rockies, Yellowstone, Glacier, and Rocky Mountain National Parks.

Annual average pH's of less than 5.0 have not been observed in any of the national parks in the West. However, pH's between 4.7 and 5.0 which are levels approaching those known to have caused damage elsewhere have been measured at monitoring sites near those parks, notably the North Cascades, Mount Ranier, and Rocky Mountain National Parks. And annual average pH's of less than 5.0 may be occurring unobserved in the parks as well.

We do not know for sure. But we know that measurements during the summer months reveal seasonal pH averages of less than 5.0 in some of the parks. Among these are the three mentioned above—North Cascades, Mount Rainier, Rocky Mountain—plus Yosemite and Sequoia. Clearly, Mr. Chairman, adequate monitoring of acidic deposition in these parks is needed to determine the extent to which each is at risk.

In some sensitive areas of the West that are receiving acidic deposition, certain chemical changes have been observed. For example, some streams in the Rockies have been acidifying over the last 15 years and temporary total acidification of a lake at Mexican Cut in Colorado has been observed after spring snowmelt. Temporary total acidification of a lake was also observed following a heavy rainstorm in Sequoia National Park.

Mr. Chairman, there is a potential threat to the sensitive areas of the western park in Western United States. This is a disturbing discovery, but one that does not need to be negative. By making this discovery now, by identifying the different sources of acidic deposition and the sensitive areas in which they are likely to cause damage, we have a great opportunity to act in the public interest before serious harm can occur. This brings me to the second point, called opportunity.

It has been rare in the natural history of our country, and rarer still in the few decades that have marked popular environmental awareness, that our people and their policymakers are in a position to anticipate a serious situation and take steps to correct it before irreversible damage occurs.

I submit that we have that rare opportunity today: the opportunity in the West to avoid damage similar to that occuring now in the East. We should not wait until crises overtake us, and the solutions become quite expensive. Nitrogen oxides, and to some extent, sulfur dioxide emissions will continue to increase through the end of this century.

While current information justifies concerns about present levels of acidic deposition in the West, some questions require further study and research. To date, identification of all sensitive regions receiving acidic deposition in the West has been limited by the paucity of monitoring site, particularly at high elevations where ecosystems are most sensitive.

In addition, more intensive and comprehensive research on the response of western watersheds to acidic deposition would help to determine furture rates of chemical and biological changes in acid-sensitive ecosystems. Further effort is also needed to characterize the biological consequences of multiple pollutants, such as ozone in combination with acidic deposition, on trees.

We have also identified a number of regulatory and public policy actions. Together with the research and monitoring recommendations, they constitute what we believe is a sound beginning for a western acid rain strategy, one that is justified given what we know and what we do not know. These accommodations reflect, at a fraction of the cost we would have to pay before acidification damage begins.

When onset of damage occurs, rapid and extensive deterioration could follow. This has been the pattern in the damage to west German forests whereby in 1982 and estimated 8 percent of the forests were reported as damaged and by 1984 the figure had claimed on 55 percent.

In conclusion, Mr. Chairman, let me commend you for investigating the potential air pollution threats to our previous national parks while there is still time to act rationally and responsibly. Too often, environmental actions by Congress and the Federal Government have had to be reactive. Today, we have the opportunity to anticipate the threats to our valuable parklands and resources and act before serious damage occurs.

I would be glad to answer any questions you or the members of the committee may have. Thank you.

Mr. **Vento**. Doctor, thank you very much for your testimony. It was an excellent summary. Frankly, it is difficult to, given the magnitude of the problem and the substantial work you have done, but I would recommend to members, if I could, that they have a copy of the more complete study to look it over, even State by State, for instance, on the various States in the West that are outlined there with the impact on them.

Most of the data from this was taken from a study that is being done initiated by the Canadians, the National Acid Deposition Information; is that correct or not? They initiated that?

Mr. **El-Ashry**. Well, no. It is some of the data—it is some of the data for the projections for air pollution, air pollutant emissions that are included in our study. That was taken from the memorandum of agreement between the United States and Canada.

Mr. **Vento**. What is the title of that program?

Mr. **El-Ashry**. It is not a program. It is called the memorandum of agreement, working groups that put together in the last 3 years representing the United States and Canada to discuss their findings within each of the countries and where they ought to go with any pollution control programs or acid rain control programs.

That, of course, has been broken down and there is a new initiative as a result of President Reagan's visit to Canada whereby Mr. Lewis will look into the issues together with representatives of the Canadian development.

Mr. **Vento**. Acid deposition occurs in wet form and in dry form. Can you give the committee some idea of what the dry versus wet is in the West and East? I think that is important. Your measure, you go largely West.

Mr. **El-Ashry**. It certainly is. In the East it is recognized or accepted by scientists that the ratio of dry to wet is 1 to 1 because of the amount of precipitation that falls there. In the West, on the other hand, the cause—because of the aridity of the climate and the dryness of climate, the ratio of dry to wet is much higher. It varies according to the area we would be talking about. If we talk about the Northwest, because of the high amount of precipitation, it probably is about 1 to 1 similar to what it is in the East.

If you talk about southern California where it is very dry, the ratio could be as much as 15 to 1, 15 dry to 1 wet. In an area like the Rocky Mountains, for example, probably it would be on the order of three or four dry to one wet.

Mr. **Vento**. For instance, in the West, we hear about he alkaline of material in the soils, the alkaline, of course, are substances that neutralize the acids. Why is it—isn't there a significant amount of alkaline capacity in some parts of the West. Maybe you could address the difference in terms of alkaline capacity in the West and how it results in having a greater or lesser risk in terms of damage of these areas, vis-a-vis acid deposition.

Mr. **El-Ashry**. The amount of alkaline reserves that would help in neutralizing the acid deposition or acid rain occurs at low elevations. So for example, in most of the low areas in Arizona there is a high concentration of these alkaline materials, so while the rain is acidic as it is in some other areas, its potential for causing damage at the low elevations is very small because of existence of this alkaline material which also, because of the dry climate, gets picked up by the wind and becomes particles, particulate floating in the air. That tends to neutralize some of the acid before it even falls on the ground.

As we go higher up to the higher elevations, these dust particles do not rise that high in the air column to this high elevation. So what we are left is the arc which does not have much at all of these carbonate materials, its igneous and metaphoric rocks that do not include carbonates in them. And you don't get the alkaline at the higher elevations. So we are left with acidity of the rain then working directly on the very alkaline waters and soils that exist at the high elevations.

Mr. **Vento**. So these areas that would normally be the most untouched by man are actually the most adversely impacted by even a slightly acid type of rain because the rain in the West is slightly less acid than that in the East; is it not?

Mr. **El-Ashry**. If you would describe how that occurs and what the sources of these acids are generally, you mean not specifically pointing a finger at anyone, but whether they are natural occurring and are man made. There are clearly naturally occurring acids in the West as there are in the East, but it is the manmade culprits in the acid rain as well as other pollutants that one focuses on in terms of control.

We cannot control what comes from nature. In addition, the amount that is contributed by man is more significant than the amount contributed by nature. So that is one. The other point is in relation to the sensitivity of these ecosystems because of their characteristics, which I described the lack of buffering capacity at high altitudes, steepness of the terrain, amount of snow that falls on them, that makes them much more extensive than the ecosystems that exist in the East.

So while we have less acidity or the rain is less acidic in the West, it does not mean it would not cause any damage there. Scientists have not been able to determine a safe level of acidity for the rain below which damage would occur. So in Scandanavia, for example, in some of their very sensitive watersheds or ecosystems that would be similar to what we are seeing at the high elevations in the West, it takes much less acidity or loading of acidic material to cause damage there and that would be on the order of about 15 kilograms per hectare of wet sulphate deposition.

That translates into about somewhere between 4.6 and 7 pH. On the other hand, in the East and Northeast, the scientists have determined that somewhere between 20 and 30 kilogram per hectaire of wet sulphate would be an acceptable level or threshold for damage there. That translates to about 4.3, I believe, or 4.4 of pH.

Mr. Vento. The point is, Doctor, I think that we are getting into some detail, and I understand that—but I think what you are saying is there is more capacity in the East to tolerate a lower pH than in the West because of the unique characteristics and inability of those particular site specific areas to buffer the acidity.

The last point, I guess, is to try to get you to go a step back. You are a geologist. Geologists often deal with geologic history, of course, but do you have any comment about more recent history on changing characteristics of the pH of rainfall if the pH of rainfall continues—has it occurred in recent decades even though it goes beyond the data? Is there any way to look at lakes or the ecosystems in these sensitive areas and suggest that, for instance, that it has not always been that acidic?

The pH has recently been lowered. If it had been at a lower rate, it would have damaged these systems long ago. Would you care to comment on that? We like to predict ahead and don't like to go back. I note you don't do that in here, but I think you get the idea of what I am trying to ask.

Mr. El-Ashry. Yes, yes. It is a question that there is not much agreement among scientists on. That is the question of trends. Has there been a trend of decreased acidity over the years. I think that is going to be debated just like many of the other complex questions that are there. But in our study, we feel that we have identified what would seem like a trend, slight as it may be, toward increased acidity in the lakes and streams that have been monitored.

Again, the caveat here is that there has been really very little monitoring in the West, particularly at high elevation, which are the most sensitive. That is why we call for an upgrading and increased monitoring in these areas that would be able to—enable us to understand better some of these friends. But based on the limited data, we think that there has been a slight trend toward acidification of these bodies.

Looking down the line, clearly if the levels increase or even remain the same as they are now, one would expect damage to take place. The part that we cannot really say is in how many years. No one has been able to predict that and I don't think I would stick my neck out on that either.

Mr. **Vento**. The gentleman from California, Mr. Lagomarsino.

Mr. **Lagomarsino**. Thank you very much.

Doctor, you stated in your presentation here and it is stated many times in your report that there are still many unanswered questions which make it difficult to prescribe solutions, which I think many people say.

Would you say that additional research is the thing we should be doing more of now? Is that the No. 1 thing we should be doing?

Mr. **El-Ashry**. It is one of the things that we are recommending. And one of the things I would repeat again, we need more research and more study and more monitoring so that we can fill in some of the gaps and some of the space as far as our base of knoweldge.

But at the same time, there are certain things that we know that would certainly benefit from controls. Reducing nitrogen oxides in southern California clearly benefits the trees and the other ecosystems in Yosemite and in Sequoia, if not from acid rain, at least from ozone where there has been damage already from ozone to the trees in southern California.

Mr. **Lagomarsino**. How much of the problem is due to the smelters in Arizona? Have you been able to measure that?

Mr. **El-Ashry**. It really depends on the area we are looking at. The smelters in Arizona and eventually the smelters in Mexico will contribute sulfur dioxide mainly on the western slopes of the Rocky Mountains. But we cannot look, for example, at Yosemite or somewhere in the Northwest in the Cascades and talk about smelters in Arizona.

As far as their contribution, we believe they are a major contributor to the sulfur that is deposited on the western slopes of the Rockies. But, in addition to the smelters, we believe the powerplants, large powerplants, particularly in the Four Corners area, are also a contributor to that sulfur.

Mr. **Lagomarsino**. I might say with respect to your next point about the United States and Mexico that at the Mexican Interparliamentary Conference held just a week ago, to which I was a delegate, that was one of the things that was discussed, although most of the discussion was the other way with Mexicans complaining about what we were doing. But this was one of the items that was brought up. I appreciate seeing it in your report.

You, in your report, on page 20, indicate the emissions that are—the sulfur and other SO_2 compounds that come from biogenic sulfur emissions in the East. And then you say, since no comparable measurements of sulfur emission rates from Western soils exist, biogenic sulfur emissions from the West cannot be estimated.

Is that true of all the kinds of biogenic sulfur sources that you mention in your report, that you are not able to measure any of those, or they have not been, I should say?

Mr. **El-Ashry**. No, they have not. As I say, it cannot be exactly estimated. But somewhere later on we say then the estimate from these Eastern United States would be a reasonable estimate for the Western United States, as well, as far as the ratio there. But this is a difficult question, and I remember in the last 5 years the estimates of the ratio of natural emissions to man made used to be on the order for the Eastern part of the United States—were on the order of, like, 10 to 1. That has been going down and down and down over the years as we learn more about the man made emissions.

Some people thought the marshlands in the Gulf of Mexico perhaps are contributing most of the sulfur that is falling in the Northeast, as well as in Canada.

Mr. **Lagomarsino**. You mentioned ocean surfaces and sulfur. Obviously, that has to be a factor because, for example, where I live there are a lot of natural oil seeps which obviously contribute to that—probably not as much as the man made ones—but it is a factor.

Mr. **El-Ashry**. It is. However, with the oil, what we are really talking about as a source of emission is the amount of fuel that is burned by the petroleum production activities and not just from the fact that they are producing the oil. But they burn oil, and the emissions from that we talk about.

Mr. **Vento**. If the gentleman would yield.

If I remember reading that right, you talk about salt sulfates from the ocean, not necessarily from oil sources—is that correct?—in terms of background, naturally occurring sulfates?

Mr. **El-Ashry**. Yes. That is why I clarified the point about the sulfur and oil.

Mr. **Vento**. Thank you.

Mr. **Lagomarsino**. Thank you, Mr. Chairman.

Mr. **Vento**. The gentleman from Georgia, Mr. Darden.

Mr. **Darden**. Thank you, Mr. Chairman.

Dr. El-Ashry, it seems that practically every company who is perceived to be a potential emitter of sulfur dioxide, including the TVA where you were once employed, seems to be taking some action and spending significant amounts of funds in an effort to at least reduce the emissions or to show perhaps they are not involved in the overall problem.

It appears to me that perhaps the solution to this problem might be a Government-sponsored or directed acid rain research initiative, perhaps, where these companies, rather than spending money within their own facilities, might contribute to some type of research fund, maybe as—you might say, a Superfund connected to the research in acid rain.

What do you think is the overall solution? How can we best determine the extent of the problem? And then, what would be—assuming the problem is here as we see it, the solution? What can we do?

Mr. **El-Ashry**. I believe you are asking me to put now a hat on that looks at the United States, and not just the Western United

States, based on my past experience, and not just on the report that is there.

My personal view on that is that we know enough about what is causing acid rain and where it is coming from to formulate an acid rain control strategy by reducing the emissions that are known to cause that acid rain from the sources that are mostly contributing to it. The target for that reduction—whether it is 12 million tons of SO_2 a year, or 10, or 8 million—that I think can be discussed and can be resolved. But the control program, I believe, is one that is warranted based on the knowledge we have at this time.

How to go about financing it, that is another question. In my personal view, also, it is that all of our environment, the regulations over the last 20 years, it has always been the polluter that pays. I honestly believe we ought to maintain that rule. It is a good rule. I don't think we ought to have some parts of the country subsidize other parts of the country for the style of living that they are conducting, or for whatever it is that they are causing.

Mr. DARDEN. Thank you.

I yield the rest of my time, Mr. Chairman.

Mr. VENTO. I thank the gentleman.

The gentleman from Utah, Mr. Hansen.

Mr. HANSEN. Thank you, Mr. Chairman.

Doctor, I appreciate your excellent testimony and the work you have done. I hope I have the opportunity to read this book that you have put out.

The thing that bothers me just a little is, rather than a blanket approach to the acid rain problem, as we see it in the West, don't you agree that the nature of the West in and of itself would demand that any plans on acid rain be tailored to each individual region?

Mr. EL-ASHRY. Absolutely. That is exactly what we are saying in the report. We do not say—in my last answer, I was talking about the Eastern United States, and that is when I say I changed hats. But in talking about the West, it depends on the region we are talking about, because the sources are very specific for these regions, even in the West, and our recommendations address that specifically.

We do not talk about a blanket program for the Western States. We talk about the strategy, one that would include both monitoring, research, study, and the regulatory actions, as well.

Mr. HANSEN. As you mentioned monitoring, I was looking at page 6 of your report showing the location of the monitoring sites. I look at Nevada and it doesn't have any; Utah has one; Montana looks like it does; et cetera.

Isn't it basically rather sparse and skimpy as to the data you would likely to gather? Are there other ways—snowpack, et cetera? It seems to me that is pretty vague.

I am not in any way discrediting what you say. And I agree with the chairman; it is the responsibility that this committee has and this Congress to look into this. On the other hand, I would hope we act on adequate information that is gathered.

I guess you are just getting your toe in there. But, if I read this right, we don't have adequate knowledge at this time. Or do we?

Mr. **El-Ashry**. What we did was to look at everything that has been done out West, and what we came up with is based on what we know, and we have identified things that need to be done based on what we don't know.

In terms of the monitoring stations, yes, they are sparse. But, see, there have been several other studies done, like by university professors, where they have monitored certain lakes, and certain watersheds, and published that stuff, and that is included as part of the base that we have looked at. In the assessment, we looked at this for this study.

Mr. **Hansen**. I guess my question is really, do we have adequate monitoring devices and adequate information gathered throughout the years, so we can draw the conclusions to know how to react to these problems?

Mr. **El-Ashry**. The data we have clearly indicates a concern about acid rain in the West, and what is needed is more of such information in particular to sensitive areas. But in other areas, we know what is happening and where that stuff is coming from. Some of the reduction in these emissions would be very beneficial before we wait and see that there is damage that is occurring. So it is a combination of the two.

Mr. **Hansen**. Thank you, Doctor. I appreciate your comment that we probably need more information.

Thank you, Mr. Chairman. I yield the balance of my time.

Mr. **Vento**. Scientists always want more information, I guess.

The gentleman from Ohio, Mr. Seiberling.

Mr. **Seiberling**. Thank you.

Doctor, I thought your statement was very impressive. Coming from Ohio, which produces mostly high-sulfur coal and burns a lot of it in their generating plants, this is a serious economic as well as environmental issue. And, of course, we are addressing it, though not as rapidly or as fully as I would like to see.

The top executives from Ohio Edison are always asking for more research; put off a decision until we have more research. And my response was, well, we do indeed need more research. You confirm that again.

But I remember when I was studying chemistry in high school 50 years ago and we were taught that if you take sulfur dioxide and mix it with water, you get sulfuric acid; if you take nitrogen oxide and mix it with water, you get nitric acid. So it doesn't take any great new research to know what the basic process is that we are dealing with—unless I am way off base.

Is that correct? Is that basically the process we are talking about?

Mr. **El-Ashry**. Well, that is the process.

I think the concern of scientists still remains on what happens when we put that acid in different concentrations on a watershed. Some will react differently from others. And that is what they need to study.

Mr. **Seiberling**. I understand how it works in particular areas, it varies from place to place, and we don't know all the answers. But we know we have a serious problem. This hearing is, I hope, going to do a job of educating the public to the fact that it is their problem; it is not some problem someone has somewhere else; it is a problem in each person's own backyard. If they don't want to see their trees die prematurely, they better be concerned. Certainly, that is true in large sections of the country, and that includes most of my State of Ohio.

So I just think that this is an extremely timely hearing and that your recommendations are right on target, particularly negotiating an agreement with Mexico to control the emissions of the new smelters that are coming on stream.

I was just reading over the weekend a report by the Environmental Defense Fund—and I see they are going to have the next witness—entitled "Safeguarding Acid-Sensitive Waters in the Inter-Mountainous West." As I read it—please correct me if I state the conclusion wrong—that existing controls will take care of the problem if there were no additions to the amount of pollutants. But when the new smelters come on, they will increase the load for the entire Rocky Mountain area to the point where there will be again a crossing of the threshold and serious damage to some of the resources.

Do you concur in that general conclusion?

Mr. **El-Ashry**. They certainly would more than offset any reduction on the U.S. side.

Mr. **Seiberling**. Yes.

Mr. **El-Ashry**. The new emissions from the Mexican smelters would be equal, if not exceed, the 30 percent reduction that may take place on the U.S. side.

Mr. **Seiberling**. Do you have any thoughts as to how we pay for these controls?

Mr. **El-Ashry**. For Mexico?

Mr. **Seiberling**. No—well, Mexico or the United States.

Should there be a general tax on all electricity produced by coal-burning plants, or should we have it come from the general revenues, or should there be some other method?

Mr. **El-Ashry**. I personally believe we ought to set targets for the industries, a quota of how much they are to reduce, and then leave them with flexibility to find the most cost-effective way, because they are the ones who know best how to go about it for their particular plant, and they pay for it.

Mr. **Seiberling**. Should the consumers from that plant carry the whole load? That could result in tremendous variations in electricity costs between one plant and the next.

Mr. **El-Ashry**. Well, it does. And perhaps one would look at it from the State perspective so there would be some equity perhaps involved there. But I think it is the basic principle of the polluter pays, and the fact that we move into really a subsidy question might just confuse some of the other environmental control issues.

Mr. **Seiberling**. Aren't all consumers of electricity from coal-fired plants contributing to this problem in one degree or another?

Mr. **El-Ashry**. In differing degrees, that is exactly the case.

Mr. **Seiberling**. Why shouldn't it be spread over the entire base, then, instead of targeted to particular plants or States?

Mr. **El-Ashry**. Because I think we would be asking some people to release only that much and others to reduce that much, and everybody pay the same amount. I think it is unfair for those who have reduced in the past to pay as much as those who have enjoyed the lower price of the electricity.

Mr. SEIBERLING. Perhaps. But there also ought to be some recognition of the regional impact where you have some regions with more high-sulfur coal resources; and if they are suddenly required to assume an additional burden, either they will close the coal mines or are going to close down a lot of their industry because the price of electricity is going to go up.

Mr. EL-ASHRY. Well, I think when we look at past history we find when the Clean Air Act was introduced and adopted, and then amended later on, no coal mines really have closed, and no electric powerplants, in terms of looking at production——

Mr. SEIBERLING. I can show you some in Ohio. And while in a way that is not an unmixed blessing——

Mr. EL-ASHRY [continuing]. If we look at the production, coal use has increased over the years despite the fact that restrictions have become tighter all the time.

Mr. SEIBERLING [continuing]. That is true.

Mr. EL-ASHRY. I think it has been offset because the technology has been developed when the standards existed. Now we are looking at new coal-burning technologies—scrubbers, and so on—that perhaps could offset some of these emissions at much lower cost.

Mr. SEIBERLING. Thank you.

Mr. VENTO. Thank you, John.

The gentleman from West Virginia, Mr. Mollohan, has become a very good student of all the problems of air pollution. He comes from a State that produces a small amount of coal. We are pleased to see him here and recognize him for questions, or for an opening statement.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

I am sorry to have gotten in on the tail-end of our witness' testimony. I did find it interesting.

I notice several of the members have asked you questions about how to fund any sort of an additional control program, assuming one turned out to be justified. I think you would concede that that is not your expertise, would you not?

Mr. EL-ASHRY. I would say I have some experience with that from my past experience with the TVA and the program done to reduce pollution by 50 percent. And we have testified before the Senate and the House on both issues before.

Mr. MOLLOHAN. That is interesting.

What is your background that gives you expertise to be able to testify with respect to how we should fund such a program should it become necessary?

Mr. EL-ASHRY. Well, I am not claiming any expertise to fund national programs. I am only expressing my personal view based on my past experience. I was asked specifically to address that, and that is what I did.

Mr. MOLLOHAN. I know. But I think it is important to understand exactly what experience you are drawing on in order to answer those questions.

To what extent, Doctor, have your studies to date been able to quantify environmental damage in the western part of the United States, if any, which you attribute to acidic deposition?

Mr. El-Ashry. As we say very clearly in the study, that we have not found reports that show or indicate that any biological damage is taking place right now. However, we continue to say this does not mean that it is not happening undetected at the present time, because there is very little monitoring and very little study looking for it out there at the remote high-altitude areas that are the most sensitive.

Mr. Mollohan. Have you conducted any studies even of a preliminary fashion in order to locate potentially damaged areas?

Mr. El-Ashry. No, we have not. What we did is, we looked at all the material that has been done, all the studies that have been done on the Western United States that we could get our hands on, both published as well as unpublished. One of the coauthors, John Harte, has been conducting actual site-specific acid rain monitoring and research on that lake at Mexican Cut for the last 4 or 5 years.

Mr. Mollohan. Would it be fair to say, then, that this document, the "American West Acid Rain Test," is basically a review of the literature on the subject and not the result of specific testing of environmental sites or attempts——

Mr. El-Ashry. It is an assessment, clearly an assessment of what is known about acid rain in the West and where the gaps are.

Mr. Mollohan. A review of the literature?

Mr. El-Ashry. Review of all the literature and some experience from actual research on the ground by one of the coauthors.

Mr. Mollohan. Based on that review of the knowledge and your knowledge in any other way, can you, or are you able for the committee to quantify in any way environmental damage, as I say, in the Western part of the United States, if any, that is attributable to acidic deposition?

Mr. El-Ashry. No.

Mr. Mollohan. So what you testify is really relating to are susceptible areas and potential sites and possible damage; is that correct?

Mr. El-Ashry. Well, my testimony is directed at—here are some facts that are known out there that show how sensitive the system is and what is happening to it in terms of acidic deposition, based on the experience we have seen in the Eastern United States and in Scandinavia and other parts of the world that causes us to be concerned—and we hope the members of this committee, as well—concerned enough to take some actions to prevent damage before it happens.

So even if damage has not taken place in the West, I think it is only prudent that we try to prevent it rather than waiting until it happens and point at it and say, "Here it is; what are we going to do about it?"

Mr. Mollohan. Right.

Mr. El-Ashry. In that respect, we feel that it probably is on the order of millions of dollars to prevent that damage from happening instead of the billions of dollars that we have seen now the damage in the East—which it may cost us to repair.

Mr. Mollohan. Are you familiar with damage in the East?

Mr. El-Ashry. Yes, sir.

Mr. **Mollohan**. Can you quantify—well, that is not the subject of the hearing. I am sure we will get to that some other time. Let me withdraw that.

Mr. **Vento**. If the gentleman would yield, the witness headed up the TVA program and I think can answer questions with respect to these things. We will talk about specific park damage, and that has been provided to you. This is the baseline work that they are doing. But I think you can address questions to him concerning the Eastern damage if you wish.

Mr. **Mollohan**. OK.

To what extent can you quantify environmental damage in the Eastern part of the United States, if any, which you can attribute to acidic deposition?

Mr. **El-Ashry**. I think the damage to aquatic ecosystems, to the lakes in the Northeast, has been well-documented.

Mr. **Mollohan**. My question is: To what extent can you quantify that environmental damage?

Mr. **El-Ashry**. Quantify in terms of how many lakes?

Mr. **Mollohan**. How many acres? How many lakes? What damage?

Mr. **El-Ashry**. I think, yes, that is well-established in the literature and as far as all the research that has been done now. Whether we will debate whether it is acid rain that causes it or not, there will always be people who continue to debate that.

Mr. **Mollohan**. My question is: Are you able here this morning to provide us some examples by quantifying that damage in the East, to the extent it exists, if it exists?

Mr. **El-Ashry**. I think the lakes, without the exact numbers of how many lakes, lakes up in the Adirondacks——

Mr. **Mollohan**. What I am asking for—you know, we talk about this subject in such generalities that I think it would be more meaningful if you could—you may not be able to do it today—but I think it would be more meaningful if you could quantify it, so we get an appreciation of the scope of the damage to the extent it might exist.

Mr. **El-Ashry** [continuing]. I don't have the numbers. I did not come prepared with these numbers.

Mr. **Mollohan**. That is really why I wanted to ask the question. But you are not prepared to do that. OK.

Are you familiar with the experience, since the passage of the Clean Air Act, of sulfur emissions from coal-fired powerplants, either in the East or the West?

Mr. **El-Ashry**. In what way?

Mr. **Mollohan**. Whether emissions have increased or decreased since passage of the Clean Air Act?

Mr. **El-Ashry**. Clearly, there has been reductions in emissions of sulfur dioxide since passage of the Clean Air Act. There is no question about that.

Mr. **Mollohan**. Since the passage of the act, there has been an absolute reduction in the sulfur emissions from coal-fired powerplants?

Mr. **El-Ashry**. If we look at it from the national perspective. From regional perspectives, that might not be the case, based on the amount of development that has taken place, and number of new plants that have opened, for example, regardless of the new performance standard they were subjected to.

Mr. **Mollohan**. So you are not able to answer the question with respect——

Mr. **El-Ashry**. I already answered it——

Mr. **Mollohan**. Excuse me.

Mr. **El-Ashry** [continuing]. On this basis.

Mr. **Mollohan**. With respect to any particular region. But overall, you say there has been a reduction of sulfur emissions; is that correct?

Mr. **El-Ashry**. No.

Mr. **Mollohan**. OK.

Mr. **El-Ashry**. The answer to your question, whether there has been a reduction, absolute reduction in the sulfur dioxide as a result of——

Mr. **Mollohan**. And your answer is yes?

Mr. **El-Ashry** [continuing]. My answer is yes, but I qualified the answer that it is yes if we look at it from the national perspective. But the answer would be no if we are looking specifically at any particular region.

Mr. **Mollohan**. What region specifically would the answer be no with respect to?

Mr. **El-Ashry**. I think some parts of the West would be examples of that.

Mr. **Mollohan**. Do you know that for certainty, or is that just a judgment?

Mr. **El-Ashry**. No, no, based on the number of new powerplants that have come on line in the West in the last 10 years.

Mr. **Vento**. Will the gentleman yield?

Mr. **Mollohan**. Certainly.

Mr. **Vento**. The other point that I think bears focusing on, Doctor, is that the cumulative effect, even though there have been reductions—in other words, it is an additive effect. If the buffering capacity was there and used before enactment of the Clean Air Act, and since remedial efforts have been made there is less buffering capacity, even though you have less loading, there is so much on the wagon, isn't there?

Mr. **El-Ashry**. And it is exactly the location of the powerplants in respect to how much they emit compared to another part of the country, like the general question of emissions in the West being much lower than in the East. But they happen to be concentrated in fewer large facilities that happen to lie upwind from very sensitive areas, and that is where the concern is. So it is not a matter of looking at a broad network and looking at the density being very small in the West as compared to the East, but where is the concentration of these things and what areas, as far as sensitivity, are they affecting.

Mr. **Mollohan**. Of course, you raise an extremely interesting question, and that has to do with the relationship between the source and any receptor area.

Mr. **El-Ashry**. Right.

Mr. **Mollohan**. That brings into question long-distance transport versus local, and the relative contribution of those particular sources on any effect on the environment in those areas.

I would be interested for you to respond to the chairman's question, as I understand it, Mr. Chairman, which raised the question of the cumulative effect of acid deposition and said accumulation in any particular areas. What have been your observations?

Mr. EL-ASHRY. That really is the cause for major concern when one looks at projections of emissions down the line. When we talk about the alkalinity or buffer, it is a very limited and finite quantity there that becomes exhausted, just like a bank, or a piggy bank. It has some money and we keep drawing from it until it becomes dry.

Mr. MOLLOHAN. The answer you are giving, is this your hypothesis, or is it based on any particular study that would support it?

Mr. EL-ASHRY. That is what the consensus of the scientific community is. As far as when you add acid to alkaline material and the situation curve and the stuff we all took in high school, and eventually some went further in college with, that is the basic principles of scientific and chemical——

Mr. MOLLOHAN. It has so much alkaline in a glass, you can add so much acid, and at some point there is no buffering capacity left.

Mr. EL-ASHRY. That is right.

And if you have a larger amount in storage to start with——

Mr. MOLLOHAN. I understand; that in the laboratory and in the test tube.

My question is, have you actually tested that in the laboratory, and whether it proves valid in the real world, and in what areas in the real world it is not necessarily valid?

Mr. EL-ASHRY. I did not test it myself——

Mr. MOLLOHAN. So there are no studies to really explain——

Mr. EL-ASHRY [continuing]. No. Because I did not test it doesn't mean there are no studies.

Mr. MOLLOHAN [continuing]. I understand that. You reviewed the literature and your report is based, you told me, on essentially review of the literature. In a review of the literature, is this question explored?

Mr. EL-ASHRY. The question is explored by John Harte, who is a coauthor of the study in the situation where there is temporary total acidification at that lake in Mexican Cut.

Mr. MOLLOHAN. In your judgment, are there enough studies on that subject to draw definitive conclusions about what areas may have this capacity exhaustion problem, and what areas may not have that problem?

Mr. EL-ASHRY. I think we see in the Northeast where that capacity exhaustion problem has been reached in a number of lakes and a number of watersheds, and as a result, there are totally acidic lakes in that case. That same situation also occurred in Scandinavia. The fact that no one was doing that kind of measurement 50 or 100 years ago to be able to see all the different intermediate steps in between, that is another question.

Mr. MOLLOHAN. I understand that.

Mr. EL-ASHRY. I didn't.

Mr. MOLLOHAN. I think really what we are trying to get at with regard to this debate is what are the facts? Because, obviously, to pass legislation that would implement additional controls, controls that are already imposed, controls on top of those imposed by the

Clean Air Act, would be a major public policy decision with a major price tag. I think what we are trying to do here is to understand the question as well as we can, empirically recognizing that it is a very complicated scientific issue and that before we go to the point of applying additional controls, we ought to understand exactly what we are doing.

So all I am doing is exploring with you what information we have with regard to this particular subject. Thank you, Mr. Chairman.

Mr. VENTO. The time of the gentleman has expired.

The point that we are trying to focus on is what the impact would be in the parks. I don't think that it is really a debate in terms of science, whether or not the buffering capacity can be used up. Of course, if that buffering capacity is used up or does not exist, obviously then we can have problems.

We will get to specific points with regard to damage in the parks, that may be within the law or outside the law or the subject of further agreements. But I appreciate the gentleman's efforts and the work of the gentleman from West Virginia. I want to thank you, Dr. El-Ashry, for being here and for the work that you have done in terms of this base line study on the Western resources. Thank you very much.

Mr. EL-ASHRY. It has been my pleasure. Thank you.

[Prepared statement of Richard G. Stein may be found in appendix I.]

STATEMENT OF RICHARD G. STEIN, PRINCIPAL IN STEIN PARTNERSHIP ARCHITECTS, REPRESENTING THE AMERICAN INSTITUTE OF ARCHITECTS

Mr. VENTO. The next witness is Richard Stein, principal in Stein Partnership Architects, representing the American Institute of Architects.

I might say I am pleased that the institute has taken a strong interest in these hearings and is offering testimony with regard to this subject. Mr. Stein, your entire statement will be made part of the record. We would like you to summarize that in 5 minutes, if you can.

Mr. STEIN. Yes, Mr. Chairman. I will attempt to reduce the full testimony to that time limit.

Mr. Chairman and members of the subcommittee, I appreciate this opportunity to present the views of the American Institute of Architects, the professional association representing the Nation's architects. I am a member and past chairman of the AIA Regional Development and Natural Resources Committee, and we have been addressing and following this issue for the past decade.

My remarks will focus on the effects of said deposition on the materials and buildings and monuments, the subject of particular relevance to the National Park System and to the National Park Services stewardship over the physical remainders of our historical and cultural heritage.

At the heart of the architectural profession lies a dedication to harmony between nature and man. Acid deposition abuses both the built and natural environments. As architects, we are concerned about the growing body of evidence pointing to the deterioration of the Nation's buildings and monuments and their natural settings due to destructive chemicals in the atmosphere. Our strong support for efforts to rid the air of these chemicals is closely related to our commitment to man's friendly relationship with the world in which he lives.

Acid deposition's effects on buildings and monuments occur in a variety of ways. Pollutants can be delivered to the materials not only as acids mixed with precipitation, but also in the form of chemical gases or particulates that then combine with oxygen or moisture to form strong acids. The acids eat away the materials they contact.

Stone, metals, paint, and other materials suffer different kinds of damage depending on such factors as the type of material, the means by which acid pollution is delivered to the material, and the force with which the pollution impacts. Marble, limestone, and concrete can be particularly susceptible to acid deposition damage. The acids in precipitation can act on the calcium carbonate in the material to form water-soluble gypsum that erodes and washes away the structure surface.

Building features protected from direct contact with precipitation can suffer even worse damage from deposition than from acid precipitation. For example, instead of washing away, the gypsum formed on stone crystallizes in the material's pores, creating enormous pressures that ultimately cause spalling. This process also has serious implications for reinforced concrete where the acid deposition causes the water to enter the material and eventually for the steel to rust. The rusting metal expands and the concrete cracks and, in turn, becomes more vulnerable to weathering. The failure of reinforced concrete was the major factor in the 1967 collapse of the U.S. Highway 35 bridge between Ohio and West Virginia which killed 46 people.

While no precise dollar figures can be placed on the economic consequences of acid deposition, numerous studies have suggested a cost of enormous dimensions. In 1979, the Council on Environmental Quality estimated that materials damage due to acid deposition amounted to $2 billion a year. An examination of air pollution damage to materials in the Boston area in 1983 concluded that sulfur dioxide effects on paint could cost as much as $31 million, while a 1972 study on paint damage nationwide put the cost at $540 million.

The effects on historic structures and monuments can be devastating. Cast bronze on sculptures and monuments reacts strongly to acid pollution, with studies showing that some monuments have lost a third of their surface metal. Copper flashings on roofs and at windows and doors can be attacked by acids, permitting water damage to the basic structure. It is believed that acid pollution has had a significant impact on the Statue of Liberty, which is now undergoing a $100 million restoration.

Italy recently authorized $200 million over 5 years to restore ancient monuments in Rome, while West Germany plans to spend $10 million a year for 10 years just to preserve medieval stained glass.

The dollar cost is relatively insignificant compared to the aesthetic and cultural deprivation resulting from the effects of acid rain on materials. All across the country, thousands of outdoor sculptures and monuments and thousands of irreplaceable historic structures, all of which are unique human statements, are undergoing slow but sure destruction from acid pollution. And as they become lost, a part of the national soul and of the national memory goes with them.

From the research that has been conducted, architects can apply important lessons to reduce acid deposition effects. For example, in places subjected to air with heavy concentrations of sulfur and nitrogen oxides, it may be more prudent to design buildings with exterior features that allow water to wash down the surface of buildings. Although this could lead to surface erosion, it may be preferable to overhangs and projections that while protecting from erosion permit the buildup of gypsum crystals that can cause severe spalling.

On the other hand, in areas where acid rain, rather than deposition, is the major problem, traditional wall projections may prove to be the best protection against acid pollution damage. Architects can also minimize acid deposition damage by specifying certain acid-resistant building materials where appropriate, such as glass, finishes with baked-on enamel, or concrete with low tricalcium aluminate content, and by noting that use of certain materials next to others, such as sandstone next to limestone, makes them more susceptible to acid damage than other materials combinations.

As we all know, however, the only lasting solution is the reduction of acid pollutants in the atmosphere. We agree that more research is needed to bring about a clearer understanding of how chemicals in acid deposition react with materials, how sulfur and nitrogen compounds spread in the air from their sources, and what particular mitigation techniques will be most effective in dealing with the problem. At the same time, we believe that sufficient data has become available to determine principal chemical culprits and that the time is past for development of a Federal plan of action to reduce acid deposition.

The AIA is deeply disappointed that the Congress has bogged down in attempts to deal with acid rain. The AIA is also disappointed in the administration's failure to support acid rain mitigation, in favor of additional research. Its position appears to contradict the findings and statements of several executive branch agencies and commissions.

For example, the executive director of the National Acid Precipitation Assessment Program recently told a House committee that there may never be a perfect scientific answer to help decide whether to impose legislative restrictions on sulfur and nitrogen oxide emissions to control acid deposition, and the Congress must judge when such controls are justified.

A 1983 report of the White House Office of Science and Technology Policy concluded, "If we must wait until the scientific knowledge is definitive, the accumulated deposition and damaged environment may reach the point of irreversibility."

Along with the program should come research. The AIA supports the administration's request for additional funds for research. We are concerned, however, that research on materials has not received the emphasis it deserves, despite its promise as evidenced by early results from the Research Triangle Park, NC, study site. Of the $85 million requested for fiscal year 1986 for the National Acid Precipitation Assessment Program, research into the effects on materials and cultural resources would receive only $2.1 million, or only 2.5 percent of the funds recommended.

Mr. Chairman, as designers of the country's commercial and residential projects and of the rehabilitation and restoration of this Nation's monuments and historic and cultural structures, we see the work of our profession slowly deteriorating because of pollution in the very air around us. From that experience, we have developed an awareness of the great need and urgency for the Federal Government to act to reduce acid pollution. We ask that it be done.

This concludes my testimony. I will be happy to answer any questions you may have.

Mr. VENTO. Mr. Stein, I think that I am very pleased with your testimony and the positive information that you have provided. With regard to the effect on monuments and effects on buildings and so forth, I think it is exactly what we are getting at. You are not the experts, you don't know what the standards should be or how we should implement them, that is our job in a sense of establishing policy and turning it over to the bureaucracy, in the best sense of the word, in getting the job done.

At the level you are looking at it, you are looking at buildings, monuments, and what architects can do to defend that. But the point you are trying to make probably is that there is accumulated damage. I am very impressed with the number of specific examples that you provided, not only in this country but other countries, various studies, and so on.

This seems to suggest it really is not a debatable effect, whether air pollution is having an effect on the surfaces of buildings and monuments. Is that basically right?

Mr. STEIN. That is fundamentally our point of view. The damage is visible, it is irreversible, the cultural heritage is being lost, and we know that steps can be taken to mitigate against the problems that cause the damage.

Mr. VENTO. And some of the techniques, for instance, I notice that you commented about the fact that architects are exploring means to actually insulate buildings against the damage that is occurring from air pollution causes. Are there any of those that are being successfully sold—you point out glass and other things—that are being used, for instance? Would you say that the design of buildings in the 20th century in this day and age is, in fact, reflective of the effects of air pollution and so on today?

Mr. STEIN. To the extent that techniques permit, the effort is to reduce damaging effects on the materials of buildings. We know it is a very complicated process in what is done to guard against one type of damage from acid, inducing damage of another sort, that ultimately the only solution then is the reduction of the damaging acidic deposition in whatever form. We are constantly studying the effect on different materials, the techniques for avoiding damage, but we know that damage occurs, and that it is immeasurably expensive.

Mr. VENTO. Has the AIA undertaken studies to measure the actual economic loss in dollar amounts? We know it is in the billions of dollars, I take it, in terms of this. Would you maybe respond to that suggestion, and are you attempting to get a more focused figure with regard to this damage in terms of buildings and public monuments and so forth?

Mr. STEIN. We have not done that ourselves, but we have been carefully monitoring the specific results of the national program, the National Acid Precipitation Assessment Program, where there are specific economic studies of consequences of building materials.

The figures quoted in here come in part from partial studies that have been extrapolated over bigger areas.

Mr. VENTO. Do you think that that information coming in can be extrapolated as to what the economic loss is, so when you sit down with a client, you could ask them to undertake a certain design or modification to defend against this particular type of air pollution?

Mr. STEIN. To some extent, yes. The damage is usually too slow and not measurable in a client's timeframe to permit anything more than the architect's own concern for it to enter the design process.

Mr. VENTO. Insofar as we can face up to those costs, if they are manmade type pollutants entering the environment, I am sure it is your suggestion that we attempt to try and limit that in some way prior to trying to defend it, wouldn't that be accurate?

Mr. STEIN. Yes, sir, that would be an accurate statement.

Mr. VENTO. Let's study it, but let's not use that as an excuse not to take action when we think there is a positive relationship. I don't want to mislead anybody by saying we can lime the lakes or encase buildings or monuments to protect them, because that would not work, would it?

Mr. STEIN. All the figures we have seen suggest that the economic damage is far greater than any of the assessments have indicated so far. Each new area we look into adds another factor beyond any of the figures that have been looked at before.

Mr. VENTO. I am especially impressed with your work with respect to bridges and the highway program. That is a very, very expensive investment in infrastructure, and the types of damage that occur, of course, are very significant.

Mr. STEIN. We are sensitive to reports, for example, that galvanizing on steel structures is affected by acid deposition and that this, in fact, has the cost, from a maintenance point of view, of having to paint all the structures or all of these. Often they are highway structures. But they have been designed to be maintained free, and galvanizing, the whole cost of having to paint them periodically can be added to all the other costs that are part of the results of the acid rain.

Mr. VENTO. That is the practical effect. I don't know how much more information one would need, but the fact is that States are spending millions of dollars going around painting signs which are supposed to be maintenance free, bridges which are having to be painted, they are having difficulties in experiencing cracking and spalling on statues. The Statue of Liberty stands as an example of what can happen over a period of time with varying amounts of air pollution. Some of it may be avoided, but some may not.

We are thankful for your testimony, Doctor. The gentleman from Caifornia, Mr. Lagomarsino.

Mr. **Lagomarsino**. Thank you.

Mr. Stein, you mentioned the European study estimating that a 50-percent reduction in sulfur dioxide could save $1.16 billion a year through avoidance of damage to steel and so on. Did that study indicate how much it would cost to reduce the sulfur dioxide by the 50 percent?

Mr. **Stein**. I am not aware of what the cost figure for that reduction would be, no.

Mr. **Lagomarsino**. I wonder, also, with some monuments and statues and so on, it is easily apparent that damage is being done today that wasn't being done yesterday, but a lot of the monuments in the world that have been in place for hundreds and, in some cases, thousands of years have been damaged, had damage to them long before it could be fairly charged that it was manmade pollution.

Do we have an idea of what the contributions are of manmade pollution as against what would be natural pollution or natural degradation of the structures?

Mr. **Stein**. I would think there are a number of very dramatic examples. For example, there is an obelisk from Egypt that was untouched for over 2,000 years that was put in Central Park probably 75 years ago, and in the acidic climate of New York City, the inscriptions on that are almost obliterated, so that in less than a century, the damage of our present industrial culture has erased what had stood for 2,000 or more years.

Mr. **Lagomarsino**. Apparently the Parthenon is another example.

Mr. **Stein**. Yes.

Mr. **Lagomarsino**. At least the——

Mr. **Stein**. The Cologne Cathedral is deteriorating very badly. The study, for example, of the gravestones in the VA—national cemeteries—indicates that the rate of acceleration of deterioration of marble, and it is marble that has been specified coming from the same quarries for a long time, that the deterioration, particularly in urban areas, has accelerated very rapidly in the last years.

Mr. **Lagomarsino** [continuing]. Has your organization done any research on the acid rain issue itself? I think you answered that already, did you not?

Mr. **Stein**. No, our organization has not done that as an organization.

Mr. **Lagomarsino**. Does your organization have a position on what form of corrective legislation should be undertaken?

Mr. **Stein**. Our general policy has been that the source of the pollution ought to be the corrector of the pollution. However, we also realize that it is a very delicate political situation, and our major concern is that the result of the pollution be eliminated. While we have our preference, we will accept anything that cuts it down.

Mr. **Lagomarsino**. Thank you.

Mr. **Vento**. I thank the gentleman. The gentleman from West Virginia, Mr. Mollohan.

Mr. **Mollohan**. Thank you, Mr. Chairman.

I didn't have the benefit of your testimony, but I do think I understand the drift of it. I am interested in your thoughts on the relative effect of long-distance versus local sources of pollution?

Mr. **Stein**. Well, we know that in the last 20 years the introduction of transferrence of pollutants from high stacks has had a significant effect. We have read a great deal of literature about its effects here, in Scandinavia, Germany, Canada. It seems to imply a very strong pattern of cause and effect. So we believe that this is a different type of pollution than that that occurred prior to it.

Mr. **Mollohan**. That is not based on any particular studies? Simply a general observation?

Mr. **Stein**. It is based on looking at studies that have been made through a number of university-based research projects and Government-based research projects.

Mr. **Mollohan**. The studies that I see coming out recently suggest that local pollution sources have a disproportionate impact on diminutions to the environment with respect to long-distance transport. Would you disagree or agree with that?

Mr. **Stein**. That is one of these sort of broad general statements that really has to be qualified. When I was going to architectural school, for example, the common knowledge was that you never put the housing downwind from the factory because the pollution was all the particulates coming from the stacks, and it was really just a very bad planning policy not to recognize that.

In order to offset that damaging situation, the high stacks were introduced, combustion methods were approved, and what had been a local problem was really resolved in many cases and became instead of that a regional problem, so it is not a simple yes or no answer of one against the other. We don't want to substitute long-distance pollution for local pollution, nor do we want to restore the local pollution that had occurred previously.

Mr. **Mollohan**. As a policy proposition, I think we all agree with that. What I am trying to get down to is what you know and what you are supposing. As I suggested, the literature or the reports on studies that I have seen recently, when they talk about the relationship between the local and long-distance transport, suggest that local sources' disproportional impact adversely impact environments in relation to long-distance sources.

Mr. **Stein**. I am not familiar with those particular studies, but our point of view would be that if that were the case, we would like to see them eliminated, the information on the long-distance transport, in case that there are ways of mitigating that as well.

Mr. **Mollohan**. Mine was a broad, general statement which I really concur with, a lot of the statements we are making are general statements, because we don't have enough empirical data to make them definitively. Would you agree with that?

Mr. **Stein**. Well, I would go back to the statement of the Office of Technology Assessment——

Mr. **Mollohan**. Office of Technology Assessment?

Mr. **Stein** [continuing]. Of Dr. Burnibeau. Dr. Burnibeau is the one who said there may never be a perfect scientific answer to help decide whether to impose legislative restrictions on sulfur and nitrogen oxide emissions to control acid deposition and the Congress must judge when such controls are justified.

Mr. Mollohan. I think that we would certainly agree with that.

I notice in your answers to some of my colleagues, you seem to emphasize damage in urban areas. You suggested that the New York City Monument, and some of the grave markers in your national cemeteries—you qualified that or emphasized that, in particular, in urban areas that was true.

Do you have any judgment why in urban areas we would see greater damage to these stone and monument structures than in rural areas?

Mr. Stein. In urban areas, you have the combined impact both of auto emissions and other combustion methods with the longer range acidic deposition, and one of the difficulties, of course, in making dollar assessments is their accumulative damaging effect. For example, the whole question of the cost of replacing paint—we know it is damaged by a number of pollutants in the air. If incrementally the acid deposition from high stacks reduces the life of a coat of paint on a house by 6 months, even if there are other factors that may have reduced it by a year——

Mr. Mollohan. I am sorry. Would you repeat that, please?

Mr. Stein [continuing]. Let's say the coat of paint on a house is subject to a reduced lifespan because of the acid deposition, whether it comes from nitrous oxides, from automobiles, or from sulfur dioxide emissions from plants, accumulatively there is a specific reduction—tests at Triangle Park in North Carolina have documented that quite clearly—if 50 percent of it is attributed to one and 50 percent to the other, the acid deposition program can really work against the 50 percent that comes as a result of the stacks that produce the acidic deposition. It doesn't mean that the other ought not also be reduced in order to get full benefit of the coat of paint, in order that the cost of having to do it in a shorter period of time doesn't have an enormous economic impact.

Mr. Mollohan. You are setting up a hypothetical case, are you not?

Mr. Stein. No, it is not hypothetical. There have been——

Mr. Mollohan. I mean, if 50 percent comes from this source and 50 percent from this, your point is if you reduce one, you should reduce the other.

Mr. Stein [continuing]. No, if you reduce one, it has a positive effect in itself, even if you don't do anything about the other.

Mr. Mollohan. Mr. Chairman, my final question is: Would you agree or disagree that it would be fair to say that in urban areas, where you described the damage to the stone granite works as most apparent, that a very large proportion of the damage is caused from the mobile sources, from NO_x sources?

Mr. Stein. Well, I think it is—it is another of those qualifiers——

Mr. Mollohan. That needs a study?

Mr. Stein [continuing]. I think even after a study, some would say that is really not quite definitive; it needs another study.

Mr. Mollohan. Well, can you not answer the question?

Mr. Stein. I can't answer it in those terms, no.

Mr. Mollohan. You don't know which would be the greater cause, or cause of that damage you describe, either NO_x or long-distant transport sulfur?

Mr. **Stein**. It varies considerably from one area to another.

Mr. **Mollohan**. Thank you, sir. Thank you, Mr. Chairman.

Mr. **Vento**. And the source, natural, manmade, or whatever. The point is when you say there has been an Egyptian obelisk—set up in Central Park——

Mr. **Stein**. The obelisk?

Mr. **Vento** [continuing]. It was there for 3,000 years. Put it in Central Park for 100 years, and you can't read it anymore. That seems to me a clear problem that we have, and, of course, obviously these are questions that we can address. I am hopeful that those that are producing these various manmade pollutants would be tempered. In other words, rather than passing on the cost to other things like these monuments and the Statue of Liberty and the Egyptian artifact, the Chaco National Park buildings, monuments, et cetera—these damages—they ought to be assessed for the costs.

This sort of damage should help us and motivate Congress to deal with the problem. In other words, the buck stops here in Congress, and it stops when other people start paying the tab.

So we can debate about this. The fact is there is enough knowledge and know-how to go ahead and take some action. I think what we are trying to do is point out there are other costs associated with it. What the solution is in terms of a policy standpoint, we will have to resolve that. I hope that American Institute of Architects that has presented this testimony, through your presence, Mr. Stein, would continue to take an interest in this so that the Congress is motivated to try and solve this problem.

We could save these buildings and monuments and save our national parks from this kind of cost. It would put the cost where it belongs, on those producing the pollution, rather than taking it out on our bridges and buildings and paying for it in a hundred different ways and probably at much greater cost than what it would be if we dealt properly with it in the first place.

I appreciate your testimony and really your presence and hope you will continue to develop the necessary information. This gives us hard economic decisions to make about what the costs are of this air pollution damage occurring in New York and across this country really from air pollution. So we thank you for doing that. This will be very helpful to our record.

The witness is excused.

Mr. **Stein**. We thank you for the opportunity to present this information. We expect to continue to be concerned about it.

Mr. **Vento**. Thank you very much, Mr. Stein.

Mr. **Vento**. Our next panel is Charles Epstein, staff scientist, Environmental Defense Fund; and Susan Buffone, clean air program coordinator, National Parks and Conservation Association.

We will proceed with Mr. Epstein first. Your statement will be made a part of the record, and you may proceed in the summary period of 5 minutes.

[Prepared statements of Charles Epstein and Susan Buffone, with attachment, may be found in app. I.]

PANEL CONSISTING OF CHARLES EPSTEIN, STAFF SCIENTIST, ENVIRONMENTAL DEFENSE FUND AND SUSAN BUFFONE, CLEAN AIR PROGRAM COORDINATOR, NATIONAL PARKS AND CONSERVATION ASSOCIATION

Mr. **Epstein.** Thank you very much, and I would like to thank you for the opportunity to speak before you today. I would like to turn your focus of your attention back to the Western United States and touch on some points regarding questions about tolerance for acidic deposition in the Western States. I think there are very few people who would assert that the Western States could tolerate as much acidic deposition as the East, and the question is, how much can it really tolerate?

As you have heard, we don't have as many monitoring sites as we would like, we don't have the studies that would ideally be done. So we can't reach conclusions about what is happening over a very broad region, but we have an accumulating amount of information with respect to specific sites, and we also have information from other parts of the world, which people believe are comparable in sensitivity. So through both these types of information we can say the Western States are probably getting already as much sulfate, sulfuric acid deposition as can be tolerated, if not more.

I would like to draw your attention to studies that have been done and what they show. One point is we already have observed precipitation pH's at or near 4.7 at sites in Colorado. This level is perhaps at the high end of the range at which damages begin to be seen in sensitive areas in places like Scandinavia and Sweden, where acid deposition has been studied extensively.

Furthermore, we already have measurements of sulfate deposition rates in Colorado sites which reach or exceed the thresholds for damage to sensitive areas in Scandinavia. We have a growing number of studies, in particular in Colorado, and one I am aware of in Sequoia Park in California showing elevated levels of sulfate in lake water at high elevations, elevated above what people believe to be the natural background.

Finally, as was mentioned earlier today, there are two studies, one in Gunnison County, CO and one at the same Sequoia Park site in California, which indicate that episodic or short-term acidifications have occurred associated with springtime high volume runoffs in which the natural buffering that may be otherwise available is quickly diluted, and for a short time the water body has extremely little or no remaining buffer capacity.

So from these limited numbers of sites over a large area, we would like to draw your attention to the fact that these studies, although they are not as complete as may be desired, already indicate that danger is imminent. What we expect to see is, as more studies become available, that these results will be confirmed and strengthened and extended.

There is enough sulfate falling in the Western United States already to cause problems in these very sensitive, high elevation areas. We are forced to consider what is in store for the future. As you have already heard this morning, while Mexican smelters, one expected to open this year and another one in operation and expected to triple its production in the next several years, would at least as far as we now know be operating completely without emissions controls, these will add significantly to the amount of sulfur dioxide emitted in this region.

In addition, there are other sources of sulfur dioxide expected in the region by the turn of the century related to new fossil fuel electricity production, related to synfuels and related natural gas production. So we feel that given the evidence that sulfur deposition may already be at the threshold for damage and the anticipation of possible new sources, that these hearings are extremely timely, and the time has come to look carefully at sources of sulfur dioxides in the region and continue studying natural sensitivity and the impacts of these pollutants and to watch new sources in the region.

Thank you very much.

Mr. **Vento**. Thank you, Mr. Epstein.

Mr. **Vento**. Finally, Susan Buffone.

Ms. **Buffone**. Thank you, Mr. Chairman.

I am the clean air program coordinator for the National Parks and Conservation Association. For 65 years, NPCA has served as a citizens' voice for the national parks. I am also representing the National Clean Air Coalition, and appreciate the opportunity to testify before you.

Mr. Chairman, we believe the national parks are under siege. They are being bombarded on a daily basis by man-made airborne chemicals at levels high enough to cause significant damage. Eighty percent of the red spruce found at higher elevations in Great Smoky Mountain National Park are in severe decline. At lower elevations, 40 percent of the red spruce are affected.

The National Park Service estimates that it will take $2 million to repair the damage that airborne chemicals have caused the monuments in Gettysburg National Military Park. Ozone damage to foliage is occurring in parks East and West. You will hear over the next 2 days a sad and compelling story from scientists and students about this thief stalking this Nation's national preserves, sapping the health and main life from our national treasures.

I could go on for more than my allotted time with specific examples of problems, but that is not the story I am here to tell. I have worked on a daily basis with the Clean Air Act's provisions protecting parks since they became law. Mr. Chairman, as an eye witness, I can tell you that the intent of Congress is not being fulfilled.

In 1970, and again in 1977, Congress gave a clear directive that parks and wilderness areas were to be kept clean. Small amounts of new pollution would be allowed, but only if these levels do not harm the resources of the area. For visibility, Congress declared as the Nation's goal the prevention of future and remedying of existing impairment. As you hear the damage reports over the next 2 days, I hope you will measure the state of the parks against these two congressional mandates.

For what I have seen, Mr. Chairman, to describe the Government's efforts in filling the law's mandates as slow is an act of charity. Allow me to share with you a couple examples. The visibility protection sections were added to the Clean Air Act in 1977. It was not, however, until 1983, when the National Parks and Conservation Association took EPA to court and won, did the agency begin to enforce this part of the law.

The regulations say the States or the Federal Government will monitor visibility in class 1 areas. For the 158 class 1 areas nationwide, EPA has proposed monitoring at 23 sites. They have proposed no monitors in Florida. For the entire Appalachian chain, there will be one monitoring station. For the 16 class 1 areas in the northeastern Rockies, there will be one monitor.

Both industry and environmentalists agree this is grossly inadequate. Bear in mind, Mr. Chairman, that this visibility protection program about which I speak only deals with plumes from smoke stacks. The photos of visibility degradation that you see on the right tell you quite clearly that the real problem is regional haze. Yet EPA tells me it will be 2 or 3 years before there is any program developed to deal with regional haze. That will be 10 years after Congress first directed EPA to prevent and remedy visibility impairment. You must judge whether you believe this is a good-faith effort to enforce the Clean Air Act.

These same visibility regulations over which the NPCA won its lawsuit told the Secretary of the Interior to develop a list of so-called integral vistas. It was a recognition that the visitors' visual enjoyment of the park does not stop at the boundary. The program provides specific protection for the view shed beyond the park's boundaries, but asks the State agency permitting a new polluting facility to consider the effect that the new pollution would have on the visitors' view.

The Department of the Interior published a proposed list of views in 1981, but has done nothing since. The regulations say the list must be final by 1985. I hope, Mr. Chairman, that you will urge the Department to finalize this list of views integral to the integrity of these parks' very purpose.

Mr. Chairman, protections for class 1 areas comes from both the limited budget for new pollution and a resource base determination that the so-called air quality related values of an area will not be adversely affected. The National Park Service has established a definition of adverse that is so broad that it is almost impossible for there ever to be a finding of an adverse impact in a park. This definition needs to be reexamined and open to public notice and comment.

An additional shortcoming of this air quality related values test is the National Park Service must understand both the structure and functioning of the ecosystem as well as the density and diversity of the floor and fauna in a specific park before they are able to conduct this analysis to determine whether or not there has been an adverse effect. This park-specific information does not now exist. The NPS needs to establish baselines now before this is a greater problem or before a specific permit proceeding begins.

One additional problem, Mr. Chairman, is that only class 1 areas get the kind of air quality protections we are talking about. All the national parks created after 1977 are not class one areas. Almost all the parks in Alaska are not class 1.

The 1977 Clean Air Act directed the Secretary of the Interior to review all the national monuments, primative areas, and national preserves and recommend any areas that possess significant air quality related values to be upgraded to class 1 protection. The recommendations were made, Mr. Chairman, but no redesignations have taken place. Attached to my written statement, which I have submitted for the record, is a list of specific areas which we feel should be redesignated by Congress as class 1. Better enforcement of the existing law would help and is needed.

The problem of acid rain in parks and elsewhere requires, however, a new solution. I have detailed in my statement our specific specifications or an East and West acid rain control bill. We believe that the parks are being seriously threatened but that solutions are available. We must clean up the air in the East through a comprehensive 12 million ton acid rain control program, we must protect the West by cleaning up smelter emissions, cleaning up the urban brown clouds of Denver, Phoenix, and other western cities, and by insuring that new major polluting facilities built in the West have adequate pollution control equipment.

The National Park Service needs more support so they can survey the fora, fauna, and visibility and be in a position to protect the parks' resources.

Thank you, Mr. Chairman.

Mr. **Vento**. Thank you, Ms. Buffone. I think your statement is excellent. Both of your statements are helpful. I want to commend the national parks and conservation association for their work in terms of integral vistas and the efforts they are making there.

It is an important one, and I happen to agree with you, that the reclassification of some of those areas probably is necessary, especially in Alaska, and should be accomplished at this time. At least when we move forward or if there is a movement in terms of the basic law dealing with air pollution, the Clean Air Act, we should cover this. We should move to do that. Many of them are not controversial, but at least can have the same standards we have for other class 1 areas.

Without the Department of the Interior and without the EPA taking an aggressive stance with respect to this—they refused to do that until there was a court case that mandated they come up with compliance with the 1977 law, as far as I know. I know you have been working with that, and I want to commend you.

One of the things we are trying to do is establish there is damage in the parks. I know there was a question that ran through some of this, it has come up in your testimony. What is a lichen desert?

Ms. **Buffone**. That is an area that once enjoyed lichens.

Mr. **Vento**. Maybe we should explain what a lichen is.

Ms. **Buffone**. It is a bioindicator species.

Mr. **Vento**. That are a pioneer plant, that grows in very adverse conditions on stones and gravestones and rock, on the side of trees, where there is little moisture and generally they are a primative plant. They are used as an indicator species. Is that correct?

Ms. **Buffone**. That is correct.

Mr. **Vento**. Indicative of what?

Ms. **Buffone**. Indicator of high levels of sulfur dioxide air pollution.

Mr. **Vento**. Which means?

Ms. **Buffone**. Sorry?

Mr. **Vento**. Which means that——

Ms. **Buffone**. If it is the lichen desert, the lichen SO_2, they have died out.

Mr. **Vento**. They are sensitive, they are not tolerant of high levels of pH—or low pH?

Ms. **Buffone**. Not pH, sulfur dioxide.

Mr. **Vento**. That is right, OK. So the point is that a lichen desert is where they are absent.

Ms. **Buffone**. Where they were once found but where they are no longer.

Mr. **Vento**. Or there was an absolute reduction of them or the growth rate is impaired because of high pH rainfall?

Ms. **Buffone**. That is right.

Mr. **Vento**. Or presence?

Ms. **Buffone**. That is one of the problems that I was trying to point out in the adverse impact test. In Teddy Roosevelt National Park, where the Park Service has been through a proceeding, they look to lichens to determine whether or not existing levels of air pollution were harmful. But they had no basis on which to judge what the lichens were 10 years ago in order to know what they are to do in order to project the effects.

So there is a great need in the Park Service for there to be this inventory of existing flora and fauna for the Park Service to be able to project when a plant comes in, which indicates there will be new levels of air pollution, to be able to project what effect that will have, or to make a finding today that, in fact, there is an adverse impact. There has been no national park in which there has been a finding that there is an adverse impact from air quality.

Yet I think you can see from these photos, Mr. Chairman, as well as from testimony that I think you will hear from scientists on specific damage in the parks that there is adverse impact. One of the problems is the definition of adversity is inappropriate.

Mr. **Vento**. I think you are probably correct. If someone is saying, well, what was it 10 years ago—it is impossible from a scientific standpoint to establish that. But you know there are parallels of different ways to set up, in other words, not using historical models but using comparable models, comparing a similar situation with respect to the environment, the temperature, rainfall, and so on.

Ms. **Buffone**. That is right. Much of this work is being done—can be done in a laboratory situation in which you use fumigation studies.

Mr. **Vento**. Your testimony indicates for the national parks and conservation areas that acid rain is the No. 1 problem facing the park system. Can you provide the subcommittee with other examples of acid rain impacts that you have personally seen?

Ms. **Buffone**. Other than in the national parks?

Mr. **Vento**. I mean other examples in national parks. You talked about the red spruce. Maybe you would amplify on the——

Ms. **Buffone**. One reason I didn't use as many specific examples in my testimony is because I was aware that you would be hearing from scientists which have done work in specific parks. The National Parks Conservation Association does not do scientific work, itself. We are a watchdog for the health of the parks. I felt that you would hear more specifically and with full force, I think, from the scientists doing work themselves in the parks.

Mr. **Vento**. I know you have done this work with the integral vistas program. What is the status of that today? You have said that EPA is supposed to be coming out soon with a standard with respect to that. Maybe you would like to repeat for the subcommittee what the difficulty is with the integral vista listing?

Ms. **Buffone**. Mr. Chairman, in 1980, EPA wrote regulations that were to protect class one areas from smoke stack plumes. In those regulations they provided the opportunity for the Federal land manager to identify specific views and vistas which are integral to the parks' purpose, either for the visitors' enjoyment or for scientific or cultural reasons or reasons the park was created, for instance, the views from the Skyline Drive, from Acadia to the ocean.

The Federal land manager, in 1981, published a list of these views that they felt were important to the parks. This is a service provided to the States, since the States are the ones doing the permitting for new facilities. It provides the opportunity for the State air pollution control permitting officer to understand that they have to consider both what the pollution from this plant will be in terms of public health, but also what it will be in terms of the national park, views from the national park and reasons people go to these areas.

Since 1981, the National Park Service has been silent on this list. The regulations require the list be finalized by December 1985, we are hoping the Department will be finalizing this list by that time in order that at least consideration would be given for what the impact of these new pollutions would be on these views from the parks.

Mr. **Vento**. Let me see if I can back up a moment on that. In other words, you are saying the Federal land managers were supposed to make proposals to the EPA, who put out the final list, is that correct?

Ms. **Buffone**. No, the Interior Department publishes the final list, but it was in these regulations that EPA wrote in 1980 that direct the Federal land manager to do so, but it is within the authority of the Federal land manager to publish this.

Mr. **Vento**. So when we have an administration witness tomorrow, so this would be a good question for them.

Ms. **Buffone**. I would think so, Mr. Chairman.

Mr. **Vento**. Let me ask Mr. Epstein, you have raised a question, it has been touched on a number of times, apparently we have all discovered Mexico in the last month with respect to the fact that they are putting in a copper smelter down there. I see almost everyone's testimony mentioned that. That points to the fact we have to have a cooperative agreement. Maybe you would amplify on that phenomenon.

Will this smelter be built according to standards that prevent emissions or not?

Mr. **Epstein**. They are located in close proximity to the Arizona border and that the pollution they emit will probably have impacts over the same wide region we believe that the Arizona smelters have over. I can tell you also that if not regulated, the emissions from these smelters will approach 500,000 metric tons per year. I believe they are having discussions, negotiations if you will, directed toward persuading or bargaining with Mexico to convince it to put controls on these smelters, but I have not heard anything that indicates that those discussions have reached a successful conclusion to date.

Mr. **Vento**. Mr. Epstein, your testimony focuses on the Western Resources Institute study, pointing out the sensitivity again of this area. It is your conclusion that Congress should try and recognize that there be damage occurring to the ecosystem in these Western areas, the parks and so on, unless there is something done on the issues.

They talk about synfuels plants that are proposed, urban development—is that accurate? Your organization is concerned with potential damage in these areas if indeed the present circumstances persist?

Mr. **Epstein**. That is correct. The focus of my remarks earlier had to do with aquatic resources and as you heard subsequently there are other information about certain indicator species in these sensitive areas as far as air quality and visibility.

Mr. **Vento**. Water resources is a sacred word in the West. This committee is manned by a lot of people and in fact has women on it from the West. The fact is, is the basic water supply, drinking water supply is one of those that is most potentially damaged in the West, is it not?

Mr. **Epstein**. Well, to the best of my knowledge most of the places where people have done studies so far in the West of sensitive aquatic resources, those are not in effect supplies of drinking water. However, I think if you look at the State of Washington you will find that the water supply for the city of Seattle is in fact one and the same with some of the high elevation waters in the Cascades.

Mr. **Vento**. Most of the water supply in the Colorado comes from the Rocky Mountain snowpak, that has areas where there is significant impact.

There isn't much buffering there.

Mr. **Epstein**. There can be a direct connection between deterioration in drinking water quality and acidic deposition when the water becomes sufficiently corrosive to bring metals into solution, those derived from the soils surrounding the water bodies or metals in the delivery systems.

So that is a concern, yes.

Mr. **Vento**. Like in Minnesota where we sit on three different watersheds going in different directions and don't get water from anyone else. We have all of it—at least the surface water.

Let me call on my colleague from West Virginia, Mr. Mollohan.

Mr. **Mollohan**. Thank you, Mr. Chairman.

I appreciate the witness' testimony. It was really excellent, Mr. Chairman.

Are you suggesting that new sources will not be adequately regulated and emissions adequately controlled under the new source performance standards or percentage reduction standards concerning new coal-fired plants?

Mr. **Epstein**. I think most of the concern has to do with smelter sources, one in the area of whether an agreement will be reached with Mexico; and two whether there will be any delay in the date by which U.S. smelters sources are required to comply with the Clean Air Act standards as they now exist.

We are not at this time—we are not certain of what the anticipated growth in the region would be. So we are not prepared to say that the new source performance standards as they apply to other utility concerns are sufficient at this time.

Mr. MOLLOHAN. You just don't have a judgment whether they would be adequate or not?

Mr. EPSTEIN. That is correct.

Mr. MOLLOHAN. All right.

Ms. BUFFONE. Our concern has primarily been with NO_X and both diesel engines and controls of NO_X on new sources.

Mr. MOLLOHAN. Mobile?

Ms. BUFFONE. Both, mobile and stationary. New source performance standards and percentage reduction deal with SO_2 and not with NO_X. That is our concern for the West. I think that is also reflected in the WRI study that in the West if there are—there are a lot of if's, but if the smelter in Douglas, AZ, is controlled, if the Mexican smelters put controls on; if the smelter in San Miguel is controlled, if the new source performance standards and percentage reduction provisions in the law remain and we get NO_X controls we may be in pretty good shape in the West.

Mr. MOLLOHAN. Where would you see NO_X controls?

Ms. BUFFONE. Diesels.

Mr. MOLLOHAN. Where would you see the controls coming from, enforcement of current law or would it require new legislation?

Ms. BUFFONE. It is interesting. The law is subject to interpretation. Under the provision—prevention of significant deterioration provisions, the law allows for development of a NO_X increment. Presently there is only an increment for total suspended particulate and SO_2. The law says there can be one developed but there has not been one developed, so we would like to see in legislation the requirement that there be a NO_X increment even though one could read into the existing law that one could be developed.

I think there needs to be a reaffirmation by Congress if that is needed.

Mr. MOLLOHAN. Is there any regulatory activity to develop a NO_X increment?

Ms. BUFFONE. No; not that I am aware of.

Mr. MOLLOHAN. Any proposals by anybody submitted to EPA for doing that?

Ms. BUFFONE. You mean in terms of litigation over a NO_X standard?

Mr. MOLLOHAN. Litigation, proposals, discussions, anything.

Ms. BUFFONE. We have discussed with EPA the value but I have not seen anything forthcoming within EPAP that they are developing such a strategy.

Mr. MOLLOHAN. I am interested in your thoughts about the percentage reduction requirements for new coal-fired power plants. They are pretty strict, are they not? Would you not agree with me, the reductions would be pretty significant?

Ms. BUFFONE. I think strict is a relative term. I think they are adequate.

Mr. MOLLOHAN. Tell me what you think.

Ms. **Buffone**. I think they are adequate.

Mr. **Mollohan**. I will quit on that, thank you, Mr. Chairman.

Mr. **Vento**. I thank the gentleman.

I want to thank the witnesses for their help and participation this morning and especially the work on the integral vistas for the parks.

Thank you very much.

Ms. **Buffone**. Thank you.

Mr. **Vento**. I will try to take one more panel and then hopefully we will conclude that at about 1 o'clock or shortly thereafter, but we want to have panel two, Dr. Janet Anderson, forest pathologist at College of the Atlantic; Dr. Ellis Cowling, plant pathologist, associate dean for research and director of Southern Forest Research Center and Acid Deposition Program at the School of Forest Resources, North Carolina State University; and Dr. James Galloway, associate professor at the University of Virginia.

Welcome to the committee. I am indebted to you for being present and helping us to understand a little about what the effects of air pollution are in terms of plants, and would like for all of you to know your statements will be made a part of the record.

We would like to have you restrict your summary to 5 minutes. We will call on Dr. Anderson first.

[Prepared statements of James Galloway, with attachments, Janet Anderson, and Ellis Cowling, with attachment, may be found in app. I.]

PANEL CONSISTING OF DR. JAMES GALLOWAY, ASSOCIATE PROFESSOR OF ENVIRONMENTAL SCIENCE, UNIVERSITY OF VIRGINIA; DR. JANET ANDERSON, FOREST PATHOLOGIST, COLLEGE OF THE ATLANTIC; AND DR. ELLIS COWLING, PLANT PATHOLOGIST, ASSOCIATE DEAN FOR RESEARCH, DIRECTOR OF SOUTHERN FOREST RESEARCH CENTER AND ACID DEPOSITION PROGRAM, SCHOOL OF FOREST RESOURCES, NORTH CAROLINA STATE UNIVERSITY

Mr. **Galloway**. I am not Dr. Anderson, obviously, but since I am the only fuzzy-headed scientist, they thought I should go first.

What I will do is—I am Jim Galloway, associate professor of environmental science, University of Virginia. I will give an overview of acid deposition and its effects on streams and lakes in parks in the Western, Northeastern, and Southeastern United States. Then I will speak specifically about my backyard, Shenandoah National Park.

Mr. **Vento**. Is Dr. Anderson here?

Ms. **Anderson**. Yes.

Mr. **Vento**. I got the names right but you are going to quarterback it. Is it all right with your schedule to stay past 1? Will that work out for you?

Mr. **Galloway**. Yes.

Mr. **Vento**. Dr. Galloway, please proceed.

Mr. **Galloway**. After I speak, Dr. Anderson will speak about Acadia National Park in Maine, and Dr. Cowling will speak of the acid deposition and related air quality issues, and I will give a summing up of acid deposition across-the-board.

As I mentioned, I am from the University of Virginia. I will limit my remarks to streams and lakes on the Shenandoah and after hearing Dr. Stein's testimony, I think I should be concerned about structures, the buildings at the University of Virginia, Mr. Jefferson's university which are mostly made of marble and we are somewhat concerned now about how long the rotunda of these structures will last.

The testimony that you have in front of you has a variety of figures in there. I encourage you to turn to those figures because throughout my testimony we will be referring to them.

Acid deposition has a variety of effects on materials, forests, lakes, and streams and the ecosystems that live in the forests and streams. Today, talking about streams and lakes I will give you three things that must occur to have biological effects due to acidification and acid deposition, and we will look at the parks on a regional basis.

These three things are for biological effects to occur, you have to have acid deposition, you have to have a stream and a lake that is sensitive to acidification such that lowering the alkalinity will cause reductions in biological populations, then you have to have a soil associated with that stream and lake that will allow the acids to get into the stream and lake.

Most acids that go to the stream and lake flow through the soil first.

Figure 1 of my testimony shows the composition of sulfate, that part of sulfuric acid that comes down. This is a comparison of concentrations in Northeast America to those concentrations in remote parts of the world, Australia, Indian Ocean, et cetera. The point is it shows where sulfuric acid deposition occurs. Clearly Eastern North America has values of sulfate SO_4 concentrations 8 to 16 times higher than remote areas.

The Western United States does not approach these deposition levels. That is not to say that Western United States does not have sensitive ecosystems. All the aquatic ecosystems in the mountainous areas and parks in these areas do have sensitive water bodies, sensitive in the sense that the acid deposition falling into them or that may fall into them in the future could lower the alkalinity such that biological populations would be affected.

That is the first criteria. It occurs on a regional basis to a degree.

The second criteria is you have to have sensitive systems. We have sensitive systems in all three areas. But now do you have affects? You have stream acidification occurring in these three areas on a regional basis. It is not occurring in the West on a regional basis because we don't have deposition of the levels that we have in the Northeast and Southeast. It doesn't mean it won't occur. Certainly it increases in the West, you will see regional scale acidification, all the models point to this.

Between the Northeast and Southeast, you have equivalent amounts of acid deposition, you have equally sensitive systems. However, in the Northeast you have documented evidence of regional scale stream and lake acidification. We don't have that regional scale acidification in the Southeast. The reason is because the soils, the soils of the Northeast can take, are essentially acting as a conduit for atmospheric acids, sulfuric acid that falls and passes through, hits the soil and is not stored in the soil and runs into the stream and lake acidification of that system.

In the Southeast the soils act as a barrier, reservoir for the sulfuric acid coming from the atmosphere. The technical is sulfur absorption capacity, of the Southeastern soils is greater than Northeastern soils.

So you have acid deposition in the Southeast but the soils are absorbing, retaining the sulfuric acid. That is good news because it means the streams and lakes in those parks have not been acidified on a regional basis as much as they have in the Northeast.

However, with all the good news there is bad news. The bad news for the Southeast for the soils currently acting as a barrier to sulfuric acid is that it won't last very long. There is a finite reservoir of soil material able to soak up the sulfuric acid. Our work at the University of Virginia and other universities throughout the world show that in one to three decades, we expect to see stream acidification occurring on a regional basis as we have seen in Northeast United States.

So on this comparison, let me say in the West we have sensitive systems, beginning levels of acid deposition expected to become more acidic from what I have heard this morning; and we have systems that are sensitive and soils that will not retain these acids once they fall into them.

So there is a strong potential for regional scale stream and lake acidification in the West. In the Northeast we have acid deposition, sensitive systems, soils that don't retain sulfuric acid so we have regional scale acidification of streams and lakes.

In the Southeast we have acid deposition, we have sensitive systems, but we don't have a large degree of regional scale acidification but we estimate in the next one to three decades we will.

Now I mentioned that Shenandoah National Park is in my backyard. Using that line in inclusive sense, I am part of a research team of a variety of scientists in the environmental sciences department and we have studied the impact of acid deposition in the park for the past 5 years. The project, the watershed study, is integrated. We tend to treat this national park as our outdoor laboratory, we are able to go out and make measurements in the real world and from experiments in the laboratory develop models to look at past impacts, current impacts, and future impacts of acid deposition on streams and lakes.

Figure 4 in my testimony relates to the question of in Shenandoah National Park specifically do you have acid deposition? I show you figure 4 because it shows you the concentrations of sulfate and nitrate in precipitation in the Park that being sulfuric and nitric acid relating to the concentrations of sulfate and nitrate in remote parts of the world. You see from this that there is a large-scale perturbation of the chemistry of precipitation in the Shenandoah National Park.

Our streams in the park are sensitive to acidification.

Figure 5 shows you about half the streams studied and about a third of the total park have streams, whatersheds containing streams that have low enough alkalinities such that we expect the acidification of streams to occur to such a degree that the watersheds so designated will have their biological populations in the streams affected in the next one to three decades.

How long is it going to take? I say one to three decades. Can I be more precise? I cannot. We don't know whether it will be 10, 20 or 30 years for the streams across these areas. Our knowledge is not perfect. What we do know is that acidification of streams is going to occur. Basic scientific principles say that it will. The issue is when and to what degree.

An example of a time scale acidification is shown in figure 6. This figure is a modeling run on a stream in Shenandoah National Park. White Oak Run. I won't go into the detail, but just say it is a predictive tool we have developed with our research team and those from around the world. What you see is a dotted line showing the pH of precipitation. You see from 1864–88 we say that that is the natural period of precipitation pH. We don't have acid rain.

From 1984 to the year 2004 we turn on acid rain in a bottle—easier than in the real world to do that. In the year 2004 we turn off acid rain. It is something we can do with a model that is hard to do in the real world. So we have three periods, before acid rain, during acid rain and after acid rain.

Then we see we use the model to determine how the pH of the stream there, one of those dark shaded areas in the previous graph, how the pH will respond.

You see the pH of the stream in Shenandoah Park in the 1800's was quite high, but as acid rain turned on and progressed through this period shown by the shaded area of the graph, the pH dropped steadily. The reason it didn't drop all at once and the reason it still decreases today is because of the sulfate absorption capacity of the soils.

In the beginning they take up most of it but as they fill up they take up more and more and then they start releasing morwe to the streams and the pH decreases over time.

Then you see in the year 2004 the pH of the stream begins to go back up because you have turned off acid rain, at least the bottle has. But it is not going up very fast. Just as it took a long time for the sulfate to get through the soil into the stream before it caused acidification, it is taking a long time for the stream to recover.

So relative to Shenandoah National Park what we see is it has acid deposition, very sensitive systems, it has—we have seen the stream acidification, and we fully expect that you will see regional scale acidification in the next one to three decades.

Let me say a word about this model.

I mentioned our knowledge is imperfect. The model shows this. If I were to put error bars in these numbers, they would be very large but what would not change would be the shape of this curve. We know that the pH, the basic principle says the pH of the streams have decreased and continue to decrease and will decrease more in the future as long as we have acid deposition.

Mr. VENTO. You cannot disagree that after that line, regardless of where it should have come from, you cannot disagree with where it is going to.

Mr. GALLOWAY. Exactly.

Mr. VENTO. When you say that this is not absolute, that within 30 years plus or minus 5, I guess, you would be within the range?

Mr. **Galloway**. Or plus or minus 10. We know it will occur, we know it will occur on the order of decades rather than weeks, months, or years.

Mr. **Vento**. Maybe some of these questions will be answered.

I take it, Dr. Anderson, now is your opportunity. Welcome to the committee again. Please proceed.

Ms. **Anderson**. Thank you.

Mr. Chairman and members of the subcommittee, I am Janet Anderson, I am a professor at College of the Atlantic in Bar Harbor, ME, with a Ph.D. in forest pathology. The college is located on the Atlantic Ocean 2½ miles from the headquarters of Acadia National Park. Since the fall of 1981, I have conducted research on the effects of air pollution and acid precipitation on Acadia National Park [ANP].

A variety of natural habitats occur within ANP supporting a wide diversity of species. Mount Desert Island is the northernmost limit of many temperate plants and the southernmost limit for some arctic species.

The goals for management for a national park are far different from the goals of a manager of a commercial forest. The commercial forester is concerned with timber productivity but the management at Acadia is concerned with the quality of the experience for the 4 million visitors who come to the park annually. Air pollution, acidic precipitation may reduce visitor experience by reducing the visibility, causing injury to pine trees and threatening aquatic species.

In the late 1970's after a coal-fired powerplant being built with the park downwind, the park began to monitor air quality. Several pollution monitoring projects monitor park condition. Park personnel conduct visibility studies by photographing the views from Cadillac Mountain three times a day. The park is a national atmospheric deposition site and on the average we have an annual precipitation pH of 4.3 to 4.4. The park monitors ozone and it also collects total suspended particulates, sulfates and inhalable particulates as part of a monitoring program.

Last summer I conducted a fog water monitoring station at College of the Atlantic. Our site is one of the coastal sites of the 11 sites now collecting fog and cloud water data across North America. Dr. Galloway participated in this program also.

We have had a lichen study conducted in the park and as you have heard, lichens are sensitive to air pollution, especially sulfur dioxide so it was an important project.

The park also is part of the 4S project which is designed to evaluate tree growth patterns of the eastern forest trees to estimate what extent and amount the impact of pollution has on them. This work is still under way and has not been evaluated.

We have also been involved in a project over the last 2 years, a comprehensive study of the surface waters of the park. We studied the five major watersheds in the park and this included sampling in 18 lakes and ponds and 23 streams and brooks throughout the four seasons of the year. We also took sediment cores from three lakes to give us an indication of historical trends in pH in these lakes.

Last summer there was a survey in the park on the effects of ozone on eastern white pine. This year I will be involved in a followup study attemptinig to correlate ozone effects. We already know a great deal from these projects. We have designated 10 sulfur dioxide sensitive lichen species found in the park. This tells us that currently SO levels are low in the park.

Acadia National Park is a long way from major sources so most of our material would have to be imported in and sulfur dioxide doesn't move a long distance.

On the other hand ozone levels in Acadia exceeded the Maine State standard 101 times in 1983, and we exceeded the Federal standard twice in that period. In 1984, the Maine State standard was exceeded 78 times and there were no exceedences of the Federal standard.

Still, there was enough ozone present to reduce visibility and cause yellow flecking on the needles of the eastern white pine. For some it was toxic enough to cause necrosis which is death of the needles and the needles would turn brown. If this kind of injury continues, our trees will definitely weaken to the point where they would be attacked by insects and pathogens and they will be killed.

The State of Maine estimates that for the State one-third of our ozone comes from natural occurring sources, one-third is from local emissions, in other words within the State, and one-third from long distance transport.

We know that in order to control and solve our ozone problem we are going to have to control both local emissions and long distance transport.

Acadia National Park is definitely receiving acid precipitation and last summer we found we are receiving acidic fog water. We did not—we thought perhaps the marine aerosols being out in the ocean, these would raise fog moisture levels and elevate pH. But as a whole we were wrong when we collected on August 7 last summer a fog sample which was 2.9. This air mass was associated with elevated ozone levels and it is also somewhat an unusual air mass in that it moved from the Northeast toward Southwest and over the next few days other people involved in the cloud water project in New Hampshire and New York and in Dr. Galloway's site in Virginia all picked up this extremely polluted air mass with low pH's in the cloud water.

In November I collected a fog sample three times more acidic than this event. Our other stations had mostly taken down their equipment for winter so we don't know if it was local or widespread. In the park the streams are vulnerable to continued acidic precipitation. Most of the island has bedrock and soils are thin so there is little to buffer the acids coming in, especially to the high elevation waters.

The alkalinities are low and as we mentioned before alkalinities are a measure of the waters ability to buffer the incoming acids. From the sediment records of Acadia there is a suggestion that a gradual decline has occurred in pH and alkalinity over the past 100 years. We do have one acidic pond on the island but we cannot really predict when the major lakes and streams might become acidic.

We have seen a few brooks already showing signs of acidification, especially in the spring and after heavy fall rains. The point to remember is that the reduction in pH and alkalinity is difficult to reverse. I believe it is in the best interests of the natural resources of Acadia National Park to instigate actions necessary to reduce the sulfuric and nitric acid inputs into the environment.

As I stated in the beginning, Acadia National Park is a special place with management requirements different from those of a commercial forest. Instead Acadia National Park must try for a high quality and safe visitor experience. Air pollution and acid deposition and acid precipitation are a threat to that management goal.

Thank you.

Mr. VENTO. Very good, I realize how frustrating it is when you have testimony on the specifics and are trying to summarize, but we appreciate your efforts to do so.

It will be made a part of the record. I assure you it will be read at least by the chairman and I am sure by many others.

I am pleased to call on Dr. Ellis Cowling, a plant pathologist and associate dean for research from North Carolina State University, Raleigh.

Mr. COWLING. Thank you, Mr. Chairman. It is a pleasure to appear before you today and by way of introduction, I might also mention I was one of the persons who helped form the National Atmospheric Deposition Program, the principal monitoring network for wet deposition in our country, and Dr. Galloway and I worked together in the original draft of what is now called The National Acid Precipitation Assessment Program. So we have a background of experience of some time.

But there have been several references to forestry effects and I would like to make a few comments with respect to the first of the 2 parts of my written testimony, and I will make just 4 conclusions with regard to the first portion of my testimony, and then 12 conclusions from the second part.

With regard to the effects on forests, it is very obvious that the worry in the public's mind about what is going on in our environment is very much shifting to worry about forests. I would like to mention that beginning in the late 1970's economically valuable forests containing 10 different species, I emphasize "10" because that never occurred anywhere in the world before, 10 different species of hardwoods and softwoods showed a very rapid and scientifically unprecedented series of symptoms in large parts of West Germany and nearby nations of Central Europe.

These remarkable symptoms of stress include decreased growth, thinning of foilage, abnormal patterns of shoot, foliage, and root development, abnormal reproductive behavior, and decline in and eventual death of trees; 10 species, shrubs, and herbacious vegetation. These symptoms are shown by trees growing at high and low elevation on nutrient rich and poor soils, on acid soils and basic soils, in natural stands and in planted stands, in mature forests and in young sapling stands.

It is widely assumed, my second point, and we think correctly so, that air pollutants are among the stress factors that cause or are contributing to the symptoms observed in the forests of central

Europe. I would be quick to emphasize we do not know that it is acids, we do not know that it is lead, we do not know that it is ozone, but we are reasonably certain that it is air pollutants in one form or another.

My third point is that changes in growth and behavior of softwood forests have also been observed recently in various parts of North America. A consistent and simultaneous decrease in rate of growth since the early 1960's has been reported in red spruce which has been mentioned several times this morning, and also in shortleaf and pitch pines.

It is well known that white pine has been suffering from ozone damage in the San Bernadino mountains of California for at least 2.5 decades, and a regional decline in rate of growth and also of visible symptoms in white pine has been occurring in the eastern part of the United States. The area of affected spruce forests extends all the way from southeastern Canada, north of the Acadia National Park, and continues to the southern Appalachian Mountains and especially is serious in the southern Appalachians where both red spruce and Fraser fir are affected.

Now turning to the more general matters relating to air pollutants. I was pleased, Mr. Vento, that you emphasized air pollution rather than just acids in rain. That is why as the second part of my testimony I have included a paper that I prepared for a conference held by TVA last September which is entitled Pollutants in the Air and Acids in the Rain.

If you look at page 4 of that paper, you will see a list of the major pollutants that are of concern to society and I will just mention their names quickly: sulfur dioxide; nitrogen oxides, including NO and NO_2; volatile organics; toxic elements of one sort of another; CO_2; particulate matter; ozone and acid deposition. These are the pollutants that are on the public's mind or recognized as criteria pollutants in our society.

If you turn to page 5 you see a list of all the effects of air pollutants on our society. First is human health due to direct inhalation.

Second is effects on human health due to atmospheric deposition or leaching, and later ingestion of air- or soil-borne chemicals via drinking water, fish, or other food products.

Third is materials damage. We have heard an excellent presentation on that this morning.

The fourth is increased haziness of the atmosphere mentioned by the last panel.

The next is fumigation of crops and forests by gaseous pollutants, and that is a regional problem throughout the Eastern part of our Nation, and in much of California.

Acidification of aquatic and terrestrial ecosystems, which Jim Galloway summed up neatly.

Decline of forests, and I emphasize all the question marks associated with pollutants associated with the effects on forests. We simply do not know the relative extent to which ozone, NO_x amonia, or amonium nitrogen, sulfur dioxide, acid deposition or toxic metals are affecting the forests of either Europe or the United States. But we are confident that air pollutants are involved.

Finally, the beneficial effect, fertilization of crops and forests.

Let me quickly sum up what I think we can say about the status of our knowledge of these various pollutants, and the influences which they bear in our society.

First of all, starting on page 3 at the bottom if you want to follow along, and this is very important, the elapsed time between emission and deposition varies with the pollutant in question but ordinarily ranges from a few minutes or hours to a maximum of 4 or 5 days.

This time is sufficient for dispersal over both short distances, 0-500 kilometers, and long distances, more than 500 kilometers.

The average annual zone of influence of any particular emission source extends in all directions from the source, and is roughly symmetrical with the center of the deposition field generally displaced from the source by a distance of only a few tens of or perhaps hundreds of kilometers.

For these reasons, no State or province can control the quality of air within its own borders without cooperation by other nearby States or provinces. The atmosphere over most industrial regions is very well mixed; also the distance between most sources of air pollution is much smaller than the average distance of dispersal from any given source. Again that is every furnace in America, every exhaust pipe, every smelter in America, and every powerplant in America.

Thus, pollutants, rarely if ever, occur alone; in addition, they frequently react with each other leading to new chemical products and interact so as to produce combined effects which can be additive, synergistic, or occasionally antagonistic.

For many pollutants, which is another point that came up in the hearing this morning, and biological effects, there is no distinct "threshold dose" or "safe concentration" below which we are certain there will be no adverse effects; thus, any important decrease in emissions is very likely to result in decreased adverse effects somewhere in the environment.

Significant decreases in air emissions of SO_2, NO_x, and VOC are very likely to have significant and simultaneous beneficial effects on human health, visibility, materials damage, surface water quality, and both crop and forest productivity. If a decision were reached in 1984-85 to achieve significant additional decreases in air emissions of SO_2, NO_x, or VOC, it will take at least 5 years to develop specific State, provincial, regional, national, or international implementation plans and at least another 5 years to design and build the machinery and control systems that would be necessary.

In final summary, for all of the above reasons, it seems prudent that the United States and Canada earnestly continue their historic air quality planning and evaluation procedures.

In doing so, leaders of industry and Government, notice I put industry first—should recognize that: one, research is continuing; two, an integrated—multipollutant and regional—program for management of air quality would have many advantages over the present single-pollutant and state-by-state or province-by-province methods of planning; three, cooperation, consultation, and statesmanship may produce more economically and scientifically sound management plans than legislatively mandated solutions; and four, the earliest possible date for significant decreases in emissions, except through energy conservation and decreased use of energy and materials, will be in the mid 1990s.

Thank you very much.

Mr. VENTO. Thank you very much, Dr. Cowling.

You know at any time during a hearing you are going down the road and something starts coming together. First of all, I am impressed with the very significant testimony that you are offering to the committee and by the conclusions and detail that I think most members need is here, we need this background.

It represents another 3 hours of reading for me in order to go over this carefully, and I will do so, but it is a very necessary thing for us to understand the conclusion that even if we make the decision to reduce these air pollutants, we will have 5 years to put it in place before we can get a system in place to actually see that reflected in terms of the environment.

But I do think it is very helpful for you to share this work with us, these 10 common species that are affected from the roots up to the leaves that actually exhibited these characteristics that could come only from one source, basically, and that is air pollution.

We have been trying to emphasize that not that we are not interested in the acid sensitivity of various regions of the country, my own home State of Minnesota, northern Minnesota, is much like the area in Acadia. But nevertheless, there has been emphasis, for instance, in playgrounds around our urban settings, in Minneapolis-St. Paul where we are finding out there is lead where kids are playing. The same was done in Baltimore and finally that has resulted in EPA taking a stand to take the lead out which I think is critically important.

There is a lot of it in the environment, not just in paint but coming out of the cars we drive.

But there are so many questions that one could ask, let me go back to the discussion with respect to the streams and Dr. Galloway for a moment. On your figure 4 chart, you point out the Shenandoah National Park is one of our parks that we are most concerned about, and you show the sulfate and nitrate levels in remote areas. I think of Shenandoah as being a remote area, but it is not.

When you put this down, obviously it is very graphic. For those that don't have it, I apologize, but it indicates that sulfate in remote areas is about 5, and sulfate in Shenandoah is 60. The nitrate is something like 2 in a remote area and in Shenandoah it is 25. That is the comparison I am looking at in front of me here.

The point is, where are these remote areas? Do they have similar characteristics—this is wet deposition only. So we are only measuring wet deposition. You are talking about similar characteristics in terms of natural background sulfates and nitrates, is that right?

Mr. GALLOWAY. Yes; that is correct.

The remote areas, there are a host of them shown here, Indian Ocean, Australia, Bermuda where winds are from a certain direction, Alaska, South America, South Africa, and Chile.

Interestingly, when you go to these remote areas, no matter where you go, whether you are in a remote area in the Northern Hemisphere or Southern Hemisphere or remote oceanic or continental area, the concentration of sulfate, sulfuric acid in rain is essentially identical to any other remote area.

You quoted the number of 5 for the sulfate in a remote area. That is correct. In South America, it is 5. In Australia it might be 6. In the Indian Ocean it might be 4. So we have gathered a large——

Mr. **Vento**. In our national parks it is 60.

Mr. **Galloway** [continuing]. In our national park, it is 60. We feel this discrepancy is a real difference. The same holds true for nitrates.

Mr. **Vento**. One of the points you make is that it is both good and bad. Parts of the Northeast cannot absorb a lot of acid deposition. The granitic field, the bodies of bedrock, outcrops in Canada and northern Minnesota cannot absorb a lot. This really acts as a conduit. What you see is what is occurring immediately, the damage to—at least its presence in water, its damage to the lakes in the Adirondacks.

In other places, they can absorb it. That is almost worse, isn't it? You can't get rid of it; you absorb it. Then it slowly releases that into the environment for a long time?

Mr. **Galloway**. That is correct.

One of my graduate students termed this "the legacy for our children." I cautioned him on being too dramatic. It can be viewed in that way. The atmospheric deposition, the sulfuric acid stored in the soils in many areas of the mountainous regions will be released to streams and lakes, assuming nothing is done to reduce deposition of sulfur from the atmosphere.

Mr. **Vento**. Dr. Anderson, your work in Maine is of interest to all of us because it documents specific types of damage. You mentioned the lichen issue before. That has been one of your indicators. You also mentioned the white pine, the damage to that.

Has that been the ozone damage or acid rain damage, would you say?

Ms. **Anderson**. We believe that is ozone damage. Certainly, acidic precipitation is coming down at the same time. When you evaluate in the field, you evaluate the mixture you have. We know elevated ozone levels and we are seeing acidic precipitation.

Mr. **Vento**. Let me ask you to answer this question for the committee and the record: Ozone is naturally occurring. We hear that all the time. We know the level in the atmosphere where ozone occurs in terms of the incidence of breaking down the blue spectrum of light.

Why don't you explain to me and to the members what the ozone impact is and why it is a secondary source of ozone that is associated with man's activities as opposed to naturally occurring?

Ms. **Anderson**. Ozone that is man made comes as a secondary pollutant. It is a complex kind of reaction that occurs in the atmosphere, especially after the burning of NO_x. You get nitrous oxides and then have a variety of very long, complicated chemical reactions that I am not sure anybody understands.

Mr. **Vento**. I thought I would rely on you.

Ms. **Anderson**. Ozone is one of the major products that comes out of those reactions, chemical reactions. It requires sunlight.

Mr. **Vento**. Like sulfur, some of the sulfide. Sulfur is a naturally present element in the atmosphere. But we are talking about the part that is added by man which causes the significant damage.

That is a very characteristic thing, type of damage, to leaves, characteristic to needles, and as a consequence it cannot be attributed to much other than that.

Let me turn to my colleague from West Virginia, the gentleman from West Virginia.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Dr. Anderson, in your testimony you indicated that you broke out the sources for ozone—one-third, one-third, one-third.

Ms. ANDERSON. That is an estimate by the State of Maine.

Mr. MOLLOHAN. One-third from natural sources; one-third from local sources; one-third from long distance.

What were the locals?

Ms. ANDERSON. Anything occurring within the State of Maine. It is not in the Acadia National Park per se, but occurring within the State of Maine.

There are industries, some amount of them, especially in the southern half of the State.

Mr. MOLLOHAN. In what mile radius would that be?

Ms. ANDERSON. From Acadia National Park—Portland is about a 3-hour drive. You are talking about 150 to 170 miles.

Mr. MOLLOHAN. What long-distance sources were identified, if any?

Ms. ANDERSON. They were not identified. But air masses, just as a resident of the area, they talk—you can hear on the radio they are recommending that—at times, there have been recommendations—people living on the island—that people with respiratory trouble not go outside because pollution from ozone coming up the coast from areas like Boston and New York are reducing visibility, making it difficult to breathe.

Mr. MOLLOHAN. From the urban areas, basically?

Ms. ANDERSON. Yes.

Mr. MOLLOHAN. So a long-distance source is a source in excess of 150 miles? You may not know the answer to that.

Ms. ANDERSON. I think for the State of Maine, when they are giving that one-third estimate of long distance, they mean anything outside of the State of Maine. That would be the way I would interpret that data.

Mr. MOLLOHAN. You were talking about the one event that had a particularly high percentage. I can't remember if you were talking about sulfur, ozone, or NO_x. You were saying it was a northeast to southwest air mass movement.

Where was the pollution that that air mass was carrying? Where did it come from; do you know?

Ms. ANDERSON. Working with a meteorologist shortly after that event, we could see for about the 5 days before this event we were having our air masses coming predominantly out of the Midwest, so that it would be interpreted that air masses were coming across the United States from the Midwest into our region.

There had not been any precipitation for a period of time. So the air mass would move across, and then this fog event came in and the air mass was actually moving—these do happen. Air masses then move back from our northeastern area down to the southwest.

Mr. MOLLOHAN. We got it out of the Midwest some way.

Dr. Cowling, you know we talk about pollution and the damage done. Often we cite Canada and Germany. I think it is just important for the record to distinguish the kind of air pollution laws and requirements that are in effect in Canada and Germany.

Do you know if Canada has any air emission controls?

Mr. **Cowling**. Oh, yes. Their standards with regard to ozone are tighter than ours.

Mr. **Mollohan**. What about with regard to sulfur and NO_x?

Mr. **Cowling**. We are dealing with different—the laws that are necessary in the United States and the laws that are necessary in Canada to achieve the same goal are quite different because of the—for example, we have a very much larger industrial base than they have in Canada. We have nitrogen oxide emissions limitations. Canada does not at present, and neither does Germany. Both are considering them.

Mr. **Mollohan**. The same with sulfur emissions, also?

Mr. **Cowling**. No. Both Canada and the United States have sulfur emissions limitations, and so does Germany.

Mr. **Mollohan**. Canada's sulfur emission limitations, are they not voluntary?

Mr. **Cowling**. No, they are not. They are required under the law.

Mr. **Mollohan**. What are they?

Mr. **Cowling**. I cannot tell you the specific requirements of the law. They are very similar to our own.

Mr. **Vento**. If the gentleman will yield, I can't give you the specific standards but, as I recall, visiting the Canadians it is a difference in sort of the federal system they have in which the provinces are given the goal or mandate and they engage. In that sense, they are in place.

Mr. **Cowling**. They are also different among the various States in the United States, as I am sure you are aware.

Mr. **Mollohan**. As I understand it, it was not my understanding they were mandatory.

Mr. **Vento**. If the gentleman will yield, I think you hear they are voluntary all the time, with the illusion there are no standards. There definitely are. They have all adopted them. They do exist.

Mr. **Mollohan**. With regard to Germany, if there is a difference between the Canadian density of population and industrial activity as compared to the United States, and Canada on that scale would compare favorably, Germany has a much higher density of industry per square mile and per population.

Mr. **Cowling**. Vehicular traffic, as well.

Mr. **Mollohan**. If you know, what are the emission standards in Germany for sulfur, NO_x, ozone emissions?

Mr. **Cowling**. They have been undergoing change. The Government of Germany presently is recommending a 50-percent decrease in sulfur emissions by 1992. I do not know the specific limitations. It is usually stated in parts per million in the atmosphere, and we don't use the same units they do.

I would be happy to get that information, if that would be helpful.

Mr. **Mollohan**. Do they have an emissions standard for those emissions at this time?

Mr. **Cowling**. They have them for sulfur oxide emissions, yes.

Mr. MOLLOHAN. How long has that standard existed?

Mr. COWLING. I cannot tell you. The laws in Germany were passed about the same time as our Clean Air Act. That is the current laws. There were earlier laws developed before the Clean Air Act.

Mr. MOLLOHAN. That is all, Mr. Chairman.

Mr. VENTO. Thank you.

Let me just find out, on page 6 of your testimony you talked about the possible role of airborne chemicals in declines of forests, and state that chemicals are considered to be a major causal factor in only four of the cases. These are the declines in the Jeffrey and ponderosa pine in the San Bernardino Mountains of California; the white pine decline in the Eastern United States; and you talk about Germany and the soft and hardwood reduction in Europe; and the declines in red spruce and Frazer fir in North Carolina.

In other words, the leading candidates for being the cause of air pollution are in the United States; is that right?

Mr. COWLING. That is correct.

Mr. VENTO. Is that because of the types of species we have here, or do you think because of the amount of air pollution that they are being subjected to?

Mr. COWLING. No. The amount of pollution in Germany is more severe than the type we experience. The chemicals that are involved are about the same in both countries. White pine happens to be a species which is very sensitive and for which we have developed rigorous proof that ozone is the culprit in terms of the damage there. I think the evidence is equally persuasive in the San Bernardino Mountains.

It is more circumstantial—it has not rigorously been proven—which airborne chemicals are responsible for contributing to the spruce decline we see in the Eastern United States or the other phenomenon in Central Europe. We do not have the evidence to show which specific chemical is involved or which specific chemicals are involved.

Mr. VENTO. The point is, in Germany, as an example, they say 50 percent of the Black Forest is under stress. It is either dead, dying, or has had some damage that is due to air pollution.

Is that accurate? Do I overstate the case? Does that mean 5 percent is dead, 10 percent is dead? I don't know.

I guess one of the subcommittees is going to take a trip to Germany in the near future. But the point is, if we wait, are we ever going to have the answer if we wait?

I get the feeling if we have to wait until the entire Black Forest dies, to take action in Germany, or all of the forest here is eliminated, that would be a problem, wouldn't it?

Mr. COWLING. It certainly would.

I must say, it is important I think in any democracy to understand the decisionmaking is always a problem under conditions of uncertainty. If there is a general consensus of public opinion, it would appear that quality of scientific evidence that is necessary is low.

The stratosphere ozone problem is a good example. We made a decision to ban the use of propellants and aerosol cans under substantial conditions of scientific uncertainty because it was a consensus that it was a good thing to do. We have a good division of public consensus about what to do about air pollution. Therefore, we insist upon a high standard of scientific evidence.

I think the challenge for any democracy is to weigh the quality of scientific evidence and weigh the preponderance of consensus forming in our society and eventually come to a decision.

We do certainly have a lot of knowledge that we can provide about certain aspects. That is why I mentioned all these other effects besides those before us. We know ozone is causing changes in the health of schoolchildren in southern Ontario. We know about visibility changes caused by sulfur pollution. We know nitrogen oxide and organic compounds are the principal sources of the photochemical oxidants. We don't know what the effects on forests are.

It is up to us as a society to weigh the uncertainties and to weigh the economic costs and benefits of any course of action, and then to make decisions. And the TVA decision is one which has been made without law. It was done voluntarily by that utility.

Mr. **Vento.** I think you put it very well. I think we know, for instance, that it will cost billions of dollars to correct some of these problems in terms of air; but it will cost billions if we do not.

With regard to aerosol cans, I think we should extend that to paint cans which are being used to write signatures here and there, the graffiti that we see.

The fact is that that really is a challenge we face. If we look at all this damage and see what the cost is—for aerosol cans, there was an alternative that worked. I think if we have alternatives to ease and facilitate those particular policy paths, that makes our task that much easier.

It isn't going to go down all that easy in terms of various groups. I think this panel has brought us closer to an understanding of the nature of this impact on our environment, both on streams, on forests, certainly on the parks in one particular instance, and I am very grateful for that.

I can assure you your testimony will be personally very helpful to me, and I am certain to the other Members of the committee and this Congress. I am very grateful for your role and the work you have done.

I think it is a point to be noted that in terms of the scientific community in this country, I have always been proud of the work that you have done, to be associated with that in a professional sense, and my own vein, as a science teacher, and of the spirit that lives. I am very proud, frankly, of this panel and the spirit and the reflection that it has on our future to deal with the problems.

Thank you very much.

We will be in recess until 2:30.

[Whereupon, at 1:25 p.m., the subcommittee recessed, to reconvene at 2:30 p.m. the same day.]

AFTER RECESS

Mr. **Vento.** The Subcommittee on National Park and Recreation will resume its sitting. I am pleased to see Representative Hansen here. We have a panel of witnesses this afternoon, Mr. Douglas

Latimer, Mr. John Trijonis, who incidentally is from Minneapolis, MN, and finally Dr. James Lents.

If you gentlemen would please come to the witness table. I assume that you can give testimony in the order in which your name is here on the agenda unless you are working together, as is the case with my last panel.

We will be happy to put it together in that manner. Otherwise, you are Mr. Latimer.

[Prepared statements of Douglas Latimer, with exhibits 1-4, John Trijonis, with attachment, and James Lents may be found in app. I.]

PANEL CONSISTING OF DOUGLAS LATIMER, PRINCIPAL ENVIRONMENTAL ENGINEER, SYSTEMS APPLICATIONS, INC., SAN RAFAEL, CA; DR. JOHN TRIJONIS, PRESIDENT, SANTA FE RESEARCH CORP., MINNEAPOLIS, MN; DR. JAMES LENTS, DIRECTOR, AIR POLLUTION CONTROL DIVISION, COLORADO DEPARTMENT OF HEALTH

Mr. LATIMER. Yes; I am.

Mr. VENTO. And Mr. Trijonis and Dr. Lents.

Mr. Latimer.

Mr. LATIMER. Mr. Chairman, and distinguished members of the committee, thank you for inviting me. I am pleased to be here. My name is Doug Latimer, principal environmental engineer with Systems Applications, Inc., of San Rafael, CA.

For several years my colleagues and I have been invovled in technical studies relating to visibility impairment. Under the sponsorship of EPA we developed computer models that use emissions and meterological data to calculate visibility impacts within approximately 50-mile emission sources, and more recently under the primary sponsorship of the National Park Service and EPA we have developed, tested, and applied regional models designed to calculate quality and visibility over regions spanning 1,000 miles.

Today I would like to excuse a shift in perspective regarding air pollution in national parks, that has occurred in the last few years, a shift to a more regional view of issues.

First our focus has changed from a merely exhaustive concern with pollution sources within a few miles of the national park to a broad regional concern with cumulative contributions of sources hundreds of miles from these parks.

Second, the issues of acid deposition and regional haze seem to be interrelated because of many pollutants and the many sources of pollutants by and large are responsible for both problems.

Third, it is becoming apparent that acid rain programs will have far-reaching benefits not only for a limited number of remote lakes, streams, and trees, but also for the U.S. urban population centers.

The EPA's first phase of visibility regulations was promulgated in December 1980 in response to the 1977 congressional visibility mandate. These regulations were designed to restrict the intrusion of smoke, dust, discolored smog, and haze, so-called plume blight and layeared haze, produced within the first few tens of miles of industrial facilities.

Although these visibility regulations resulted in some contraints on industry, especially on electric utilities as shown in exhibit 1 appended to my written testimony, industrial growth has not been significantly affected in my opinion by these regulations.

More recently concerns have been raised regarding the more serious visibility problem of regional haze. Emissions of fine particles, sulfur dioxide, and nitrogen oxides from urban areas and industrial facilities can be transported hundreds, even thousands of miles. These emissions chemically react in the atmosphere to form sulfates and nitrates that are the principal causes of regional visibility impairment and acid deposition.

The resulting haze is relatively uniform, extending many miles from pollution sources, and is particularly thick in the summer when photochemical reactions are most rapid. For a Government task force that has been studying when regional haze should be explicitly regulated, I was the principal investigator on two studies of regional haze, and I would like to share some of the insights gained from those two studies.

Probably the most important finding is that sulfate formed in the atmosphere from sulfur dioxide emissions is the largest single contributor to regional haze in this country. From measurements made in many urban areas and national parks, and from our own computer modeling studies, we find that sulfate constitutes about 50 percent of the manmade haze in both the East and West.

My written testimony shows the significantly different concentrations of sulfate in the East and the Southwest determined from both measurements and models.

In the East, annual average sulfate concentrations are typically 10 micrograms per cubic meter in the Ohio River Valley, while in the Southwest sulfate concentrations are typically 1 microgram in such areas as the Grand Canyon.

The factor of 10 difference in concentrations of sulfate and other fine particles between the Ohio River Valley and the Grand Canyon largely explains the factor of 10 different regional visibilities.

Visibility in the East is typically 10 miles, whereas in the Grand Canyon it is typically 100 miles. The factor of 10 difference in sulfate concentrations in the East and Southwest is also consistent with the fact that SO_2 emissions in the two regions also differ by a factor of 10. If we consider the effects of a 3-1 Eastern rain acid program that would control SO_2 emissions such controls would be expected to reduce sulfate concentrations by as much as 40 to 50 percent.

This would result in a 25- to 33-percent increase in visibility in the East. Since visibility improvements would be noticeable almost every day of the year, not only at scenic vistas in the national parks but also in urban areas, the visibility effects would be widespread in the East.

If we use economists estimates of people's willingness to pay for improved visibility, we calculate a regional visibility benefit of approximately $2 billion per year for such an acid rain control program.

Then benefits are sizable fractions of control costs, even without considering other potentially larger benefits such as reduced damages to lakes, streams, and forests, manmade materials and structures, and human health.

Another application of computer models involves tracing pollution from individual urban areas, powerplants, and smelters to find out where it is carried and deposited.

Exhibit 3 illustrates one example. Let me direct your attention to the top figure, which shows the relative effect of 1 ton/year of SO_2 emitted from various locations in the East on acid rain in the Adirondacks.

Note from the figure that a ton of SO_2 emitted in New York State would be expected to have at least twice as big an effect as 1 ton emitted in the Midwest. Multiplying these unit impacts by the current emissions in the East, as shown in the lower figure in exhibit 3, we obtain a picture of the sources contributing to acid rain in the Adirondacks, namely the Canadian smelters and the U.S. powerplants in the Ohio River Valley.

If this analysis is repeated to evaluate which sources are contributing to haze in the Great Smokies or in urban areas, we find that, by and large, the same sources contribute.

As shown in exhibit 4, a similar analysis has been performed in the Southwest using computer models.

In addition to sulfate this study evaluated the effects of any trait, soot, and other particles. We found that emissions from the smelting, electric utility, and oil industries, and from urban areas, contribute not only to manmade haze in the Grand Canyon but also to acid deposition in the Colorado Rockies.

We believe that such model calculations, together with the analysis of measurement data, will be useful in evaluating the relative contributions of different sources of SO_2 and NO_x to regional visibility and acid deposition problems.

Noting the many interconnections in ecosystems, John Muir once remarked that "Everything is hitched to everything else." Today, when we consider air pollution in the national parks, we find similar interrelationships. Pollution sources hundreds of miles distant contribute to the haze and acid rain observed in our national parks and wilderness areas.

We find that the problems of acid rain and visibility impairment are linked. As a result, acid rain controls in this country are likely to have far-reaching benefits, not only on ecosystems, but also on manmade structures, on cultural objects, and the scenic beauty of our parks and urban areas.

Mr. VENTO. Thank you very much, Mr. Latimer.

Dr. Trijonis.

Mr. TRIJONIS. My name is John Trijonis, president of Sante Fe Research Corp. For the past 15 years I have been working in air pollution research and specializing in the area of atmospheric visibility. The purpose of my testimony is to explain the visibility effects associated with proposed sulfur oxide emission controls.

The visibility phenomenon that I will be describing is large-scale regional haze over the Eastern United States. This haze is apparent to people at ground level by the wiping out or contrast loss in viewing hills or buildings from a distance.

You can also very easily identify it almost any time you are an aircraft passenger flying over the Eastern United States.

To start, I would like to explain in general terms why sulfur oxide emissions are of critical and unique importance to atmospheric visibility. The atmospheric end products of sulfur oxide emissions sulfate particles. These are liquid and solid particles composed of sulfuric acid and/or ammonium sulfate. These sulfate particles are very effective in scattering visibility light because of two reasons.

First, sulfate particles tend to form in the particle size range of 0.1 to 1 micron diameter, that we know from fundamental theory and from many, many experiments that particles in this size range are much more effective at scattering light than particles of a smaller size range or a larger size range.

Second, sulfate particles are very hygroscopic, that is, they have a great affinity for water, and because of this they draw a substantial amount of atmospheric water from the invisible gaseous phase into the light scattering droplet phase.

Those are the two reasons why sulfur oxide emissions and what they produce, sulfate particles, are important to visibility in a general sense.

Mr. VENTO. Let me interrupt you there to see if I understand that point. I think it is a very important point. Obviously the size is one that I had heard before in terms of light waves, being able to block them or to deflect them, but the other one is one that I had not heard before, and that is the ability of sulfates to actually cause the water to go from a gas to a liquid form, into a small droplet form, in terms of condensation I guess is what you are saying?

Mr. TRIJONIS. That is right. Typically said, the relative humidity of about 70 percent for a given mass of sulfate particles you have about an equivalent mass of water associated with that drawn in from the gaseous phase, and in fact, that corresponds to or accounts for the density difference of an extra volume of about, compared to the original volume of sulfate, of about 2.7 times as much as scattering aerosol.

Mr. VENTO. The point is that that condensed water is then also a visibility factor, a very significant one.

Mr. TRIJONIS. That is right.

Mr. VENTO. When we hear comments about the fact that part of this is water vapor or naturally occurring, that is to say, it is true it is actually occurring for all practical purposes, but the sulfate compounds of that particular natural substance turning from a gas to a liquid state——

Mr. TRIJONIS. That is right, if you took the sulfate away the water absorbed with it would also go away. It turns out there is orders of magnitude more in the gases than the liquid phase. If you took it away you are not going to affect it to make it attract other particles.

Mr. VENTO [continuing]. In other words, the water is associated and linked to the sulfates?

Mr. TRIJONIS. That is right, you take the sulfates away that part of the water also goes away. That is one of the reasons you find that of the fine particle mass fine sulfates might be only 25 to 30 percent but sulfates and its associated water or really you attribute it to sulfates, sulfates will account for 50 to 60 percent.

Mr. VENTO. They account as a concentration neuclea?

Mr. TRIJONIS. That is right.

Mr. VENTO. Please proceed.

Mr. TRIJONIS. Next I am going to illustrate the effects of sulfur oxide emission controls by describing visibility levels for three cases. One, current or existing conditions, two, the proposed 31-State 1,200 million ton SO_2 control strategy and finally three, natural background conditions.

For each of these cases I will be discussing average visibility levels over the entire Eastern United States. First I will describe them in terms. In quantative terms and then I will try to illustrate them with graphs. For the quantative descripton we should turn to the diagram attached at the end of my testimony. This diagram quantifies levels of visibility for the three cases.

For example, on the left-hand side of this figure I have noted that currently in the East, average visual range is about 12 miles. In scientific terms this is equivalent to a light extention level or a haziness level of 200 inverse megameters.

The length of the column on the left-hand side measures this light extension or visibility reduction.

On this I have also shown the components of this visibility reduction as determined by various field measurement programs. The important point here is that sulfates are the dominant component of the visibility reduction.

On the average, sulfates account for about 55 percent, sulfates that attach water in any case account for about 55 percent of total light extension.

The results of the 12-million strategy are illustrated by the center column. The 12-million-ton strategy would reduce SO_2 emissions by about 60 percent in the 31 State control region. This would decrease atmospheric concentrations of sulfate particles by absolutely more than 50 percent averaged over the East.

Assuming other factors remain unchanged, and that is what is indicated in the diagram here, the average light extension level would decrease by nearly 30 percent, and the overall visual range would increase from about 12 miles to 17 miles or about a 40 percent increasee.

Lastly turning to the right side as a reference point it is also interesting to consider the level of visibility that would exist if all manmade particles in the atmosphere were controlled.

As shown on the right hand the natural background visual range in the East would be approxiamtely 55 miles, about four to five times greater than the current visual range of 12 miles. Another way of saying this is that of the current visibility reduction, about 75 to 80 percent of that represents a manmade phenomenon.

Next, I would like to discuss the degree to which these visibility changes that I illustate there are perceptible. In side by side comparisons of photographs, the threshold for a perceptible difference, a detectable difference in looking at the photographs, is approximately a 5- to 10-percent change in visual range.

When the views are not compared simultaneously, so that you require memory, the threshold for perceptibility is about a 10- to 15-percent change in visual range.

Thus the 40-percent improvement in visual range for the 12-million-ton strategy wouid be quite perceptible, and of course, the 400-percent change in visual range from the current conditions to natural background conditions would be very obvious.

Finally I brought a poster that has some graphs illustrating average visibility levels for the three conditions, current conditions, the 12-million-ton strategy, and natural background conditions.

These photographs were checked as part of scientific field programs at Shenandoah National Park and Great Smoky Mountains National Park, and I would like to show those to you now if I could.

Mr. VENTO. Please proceed to do so. I don't know, if you want to bring them up, I guess there are others that want to see too. They are posters.

Mr. TRIJONIS. I am not sure if you can see well from that distance. You may want to take a look at it more closely.

Mr. VENTO. Turn it this way a little bit so that some in the audience can take a look. I can see them pretty well. I think you may want to hold them up a little higher on that desk in front of you.

Mr. TRIJONIS. On the left here are photographs representative of the current situation. These have visual ranges on the order of 10 to 15 miles. For two of these we have approximately a 40-percent increase in visual range, and these show that for the 12-million-ton SO_2 control which would produce about a 40-percent increase in visual range, that this would be perceptible.

Mr. VENTO. Place them back on that table a little further there, even if they are a little further back. We are getting a light glare from that. Bring it the other way, don't lean it back. There, that is much better.

Mr. TRIJONIS. So, as I said, for two of these cases, we have shown what would happen if you had apprxoimately a 40-percent increasee in visual range. You can see that it would be perceptible.

And then on the right I have illustrated the visibility levels that should be typical of natural background conditions. That is visibility on the order of about, these are photographs of 50 to 65 miles, and you see comparing the current conditions to the natural background conditions there is just a huge change in visibility.

These are for specific areas in the East, the Great Smokies and the Shenandoah, but as I said, I am really talking about average conditions over the entire east. That is everything east of the Mississippi and south of the Great Lakes, that if you went back to natural background conditions it would be that sort of change, and if you had the 12-million-ton strategy, you would have the change between the first and the second columns on the average.

Mr. VENTO. In other words, these photographs then were taken at a time when there was less pollution in the air, and consequently less water vapor because the sulfites weren't there, so the point was that is the exact conditions they are taken under.

Mr. TRIJONIS. That is right. These are taken under average conditions. They are slightly better than average, and in fact in the photographs themselves and from monitors, from air quality monitors, we have measured that there was that sort of a change in visual range so we can now say that this is what would happen if you on the average changed it from this condition to a 40-percent improvement.

Mr. VENTO. Very good. You might want to put those up so some of our other guests can see them, or on the side over there. There are some other easels. I don't know if that will work or not for those. Proceed with concluding your statement.

Mr. TRIJONIS. That is about it. I would just like to briefly summarize.

Sulfate particles are the dominant component of large-scale regional haze in the East. Sulfur oxide emission control would be the most important step required to reduce haze levels in the East, and the 12-million ton strategy for acid rain control would have the side benefit of producing a significant and perceptible improvement in atmospheric clarity in the East.

Mr. VENTO. Very good.

Mr. Lents, please proceed. Your entire statement will be made a part of the record.

Mr. LENTS. Mr. Chairman and subcommittee members, I am James Lents, director of the Colorado Air Pollution Control Division.

I have also been very active in trying to bring together a number of Western States to deal with same of these interstate air pollution issues such as visibility and acid deposition. I would like to make a few remarks at least from Colorado's perspective.

Visibility and acid deposition are very important issues in Colorado and the West. The West enjoys visual ranges which are unsurpassed in the rest of the Continental United States. Unfortunately, despite the uniqueness of these visual experiences, there has been a considerable deterioration of visual range in the West over the past century, and unless action is taken, we expect this trend to continue into the future.

Our interpretaton of the SAI report done by Mr. Latimer for EPA indicates that visual range has dropped from an average of over 160 miles in preindustrial times to an average of about 100 miles today. It is projected by Mr. Latimer that there will be a drop to an 85-mile visual range if oil shale is developed and smelters are allowed to continue to operate without controls. This data is clearly cause for alarm.

Acid deposition in the West has not yet become the problem it is in the East. However, given the unique qualities of Western mountain areas, for example, the lower buffering capacities of lakes and terrain characteristics, the potential for significant damage is high.

Our interpretation of a recent report by the World Resource Institute which you heard from this morning, indicates that current acid deposition rates could lead to acidification of our mountain lakes in the next 20 to 30 years. We certainly do not want to allow this to happen and then be faced with the monumental task of reversing a preventable problem.

Even before we had the SAI data, several Western States banded together on a project to develop some common approaches for developing visibility standards.

We knew that the actual level of standards would be up to the policymakers in each State, but wanted to insure uniformity in the form of standards, ease of regulations, and to assure that consistent approaches to those being regulated and to educate ourselves concerning visibility issues.

The project resulted in agreement among the States as to standard form and served to identify the many technical and policy issues needed to be resolved in the standard setting process.

One of the reasons we, in Colorado, are moving toward visibility standards is our concern over the inadequacy of the current pollution increment approach for protecting visibility in Federal class I and II areas in our State.

First of all, we do not believe the increments themselves will protect visibility. Consumption of the current class I increment for TSP uniformly throughout the West would result in another 25-mile loss in average visual range from what it is today.

This would yield an average visual range of 80 miles where it once averaged over 160 miles. If the class II increment was added to existing pollutant levels uniformly in Colorado, our visual range would decrease by 60 miles, to a 45-mile average.

We also believe the current practice of having Federal land managers assess air quality related values, AQRV's, as a means of protecting visibility in class I areas is inadequate for accomplishing visibility goals. Not only is the process arbitrary, but the arbitrary decisions are made by technocrats and not policymakers.

It is our belief that the Federal Government should establish regional standards for visibility in class I and II areas and eventually for all urban and rural areas.

The EPA presently argues that this is currently not allowed under the Clean Air Act. They argue that they are only allowed to establish national standards. This position by EPA is a prime motivator for the State of Colorado to move toward a visibility standard of its own. Clearly, a standard set to protect visibility nationwide would not protect visibility in Colorado or the rest of the West.

Another reason for taking a regional approach to visibility, and also the acid rain issue, is the contribution of long-range transport to both problems.

The SAI study indicates that more than half of the visibility impact in the Flat Tops Wilderness area in western Colorado comes from outside Colorado.

Salt Lake City is estimated to contribute 8 percent of the degradation in western Colorado, and Los Angeles is estimated to contribute 7 percent of the degradation.

The SAI study did not deal with the individual impact of industry, thus the specific interstate impact of industry could not be evaluated. To deal with this transport issue, expanded regional analysis techniques far beyond today's capabilities are needed.

I would like to discuss some of our specific efforts in Colorado, as I relate to my previous points and my interest in visual air quality.

In 1977 the Colorado Legislature decided the areas identified in the Clean Air Act as class I areas in Colorado were inadequate for air quality protection. Thus, the legislature created a Colorado category I designation to protect eight additional areas from SO_2 impacts.

This fledgling effort, although somewhat ineffective, points to the concern in our State for these important outdoor areas.

The State health department is currently undertaking studies to determine if two of these eight should be reclassified to class I areas. We feel the additional protection available under the class I status may be helpful in preventing further visibility degradation and acid deposition impacts particularly from outstate sources.

It should be noted that not only would visibility standards provide more protection, but acid deposition standards would also be better than the class I increment process.

The State health department, one, is ultimately led to the bottom line question. Is there anything that can be done to stop the decline in visual air quality and the potential acidification of our mountain lakes? Can some of it be recouped? I don't have adequate data to answer this question today.

However, I would like to provide an increment of data that provides some light at the end of the tunnel. The SAI tunnel breaks out the source of degradation as follows: Industrial sources are contributing about 56 percent of the degradation.

General manmade fugitive dust about 26 percent, prescribed burns, gasoline vehicles about 4 percent, diesel vehicles about 4 percent, other mobile sources about 4 percent, and residential commercial heating about 1 percent.

It is noteworthy that 73 percent of existing major Colorado SO_x sources and 42 percent of existing major Montana SO_x sources have no SO_x control.

If this is indicative of other Western States, then considerable potential exists for achieving some meaningful SO_x reductions in the West if it is determined that such is needed.

As much as an overall 30-percent SO_x reduction may be easily achievable based on this data. Similarly, industrial NO^x emissions generally go uncontrolled. Although NO_x is harder to control, it is likely that an overall 10-percent reduction could be achieved from stationary sources.

We have been concerned by what we consider a softening of EPA's position on the control of diesel emissions evidenced by their recent heavy duty vehicle standards. Over the next 15 years, it may be possible to achieve another 10 percent or greater reduction in NO_x emissions and fine particulates from vehicles if standards are set at the tougher end of the spectrum.

This suggests that a 10- to 15-percent visibility improvement may be realizable in addition to that accomplished through smelter control and other existing emissions control program. Of course, the advent of new sources will mitigate the potential improvements.

It would be inappropriate to use the numbers I have just provided other than to determine the need to investigate further reduction potential from existing western sources, and to continue to review the need for tougher controls on mobile sources. It is my concern that EPA and the States are not taking a broad enough view of the value of controls on many stationary mobile sources.

In conclusion I would suggest that Congress consider the following two recommendations.

One, Congress should mandate a process to develop regional visibility and acid deposition standards. There should be a mandatory set of standards that apply to all Federal class I areas since they are our national treasures.

Two or three other levels should be developed which may be selected by States for different areas such as urban, State parks, and such. The standard setting process should involve the States as well as Federal land managers. Once a State adopts standards for its different areas, a process should be established to prohibit other States from violating the selected limits in another State.

Two, simultaneous to the standard setting process, an accurate western inventory should be developed which includes emission rates, existing levels of control on sources, and the potential for reasonable further control on each source.

A process should be developed to maintain this inventory into the future. This inventory should include mobile and other area sources as well as the stationary sources. This information would enhance the process of correcting existing visibility impairment and studying the effect of adopting different levels of standards.

It should be noted that theoretically this information exists. Also, NAPAP and the congressionally funded STAR project in the West in which Colorado is involved is attempting to address this issue.

However, the NAPAP and STAR projects seem to have inadequate levels of funding for the West. In addition, many Western States have traditionally had smaller, more poorly funded air pollution control programs. This has not contributed to well developed computerized inventory systems.

Mr. Vento. Fine. I am sorry if I distracted you, Doctor, did you bring along some visual material as well?

Mr. Lents. I brought them in the form of slides, and I did not realize that I couldn't use slides.

Mr. Vento. I apologize for the amount of testimony today, and the fact that we don't have equipment for that, but I hope that maybe at some point we can get a viewing of those.

Mr. Lents. I would like to present them as photographs. This data that I brought was just available to us as of Friday of this week, and I wasn't able to get them reproduced, but I will do that for you.

Mr. Vento. I think that would be very helpful, if it isn't an imposition to have them. I think all of you recognize the value of a visual presentation, actually seeing it.

One of the things that is different I think about the visibility problem is, of course, that if there are changes that will immediately affect the improvement of the quality, that is to say, you can't change the amount of acid in the soils and so forth or the lack of buffering capacity there, as you were indicating in terms of the last panel, but here a change that occurs can immediately improve the visibility. That is the great difference, is it not?

Mr. Lents. Yes, I think you are correct. Of course, it is still a very slow process getting these things to occur. On mobile sources if we changed the law today it would take over 10 years to effectively change the fleet over. It takes years on sources.

Mr. Vento. In your testimony I particularly noted the comments about various States in the West that have a very small percentage control source of sulfur dioxide emissions. What is the reason for that?

Mr. **Lents**. I don't want you to misinterpret that. All of these sources are operating in compliance——

Mr. **Vento**. I understand that.

Mr. **Lents** [continuing]. With Federal law, but I think because we have generally lower sulfur coal in the West, it has generally been argued that control is not necessary on those sources.

Mr. **Vento**. In other words, what you are saying is that you have got basically a clean environment, and therefore it has a certain carrying capacity for absorbing sulfur dioxide based on national standards, based on State standards, so that the States haven't chosen to put more restrictive standards on.

They are relying on the Federal or national standard, which is in compliance.

Some of the powerplants, an an example in some areas of the Ohio Valley, are grandfathered so they are in compliance. They might be spewing out thousands of tons of sulfur dioxide but they are in compliance. That is the problem we have too. Your problem is a little bit different in the sense that there is a certain carrying capacity that is suggested that can be absorbed.

Am I correct in that? I guess you would probably like to add a little fine point to that.

Mr. **Lents**. I don't have a big difference with you on that issue. I think we have traditionally looked at eastern control levels, and even with scrubbbers with a lot of the high sulfur eastern coal the levels can be dropped, so that our levels without control look pretty good compared to a lot of the eastern emissions with controls.

However, because of the natural visibilities that are so extensive in our area, those sources do create or can create a fairly large impact, so it is something I think we in the west need to consider. It is a point I have been trying to raise not only to you but to a number of the other people in the West.

Mr. **Vento**. In other words, the blue sky might get a lot smaller.

Mr. **Lents**. Right.

Mr. **Vento**. The blue sky country in Montana that is and maybe Colorado and other places which have had these spectacular vistas have significantly been adversely affected.

The other point is relative to the comments that have been made by your colleague, Dr. John Trijonis, and that is the sulfate issue. The sulfates, while they may not make up 50 percent of the pollution in the air do contribute more significantly to the visual pollution, do they not?

Mr. **Lents**. They contribute quite a bit I think because they represent relatively higher. It is a big argument when New York or NO_x is the worse character. In the West there are more two emissions than SO_2, therefore, SO_2 place a larger role in the problem.

I think the issue that you get into, no single source is a big problem. If you try to analyze, I mentioned Los Angeles, or smelters. When you look at western Colorado they will only be a few percent, and everybody is that way, and that is the difference that most sources make when you go to them. They say "Well, we are just have a percent of the problem or one-tenth of the problem. Go get someone else." That was the point I was trying to make. We are going to have to take a broader look at all of these pollution sources.

Mr. VENTO. You are saying that any oxide is a more important problem in the West than sulfates?

Mr. LENTS. I think that is arguable, but that is the general feeling that I have gathered from the data that I have looked at.

Mr. TRIJONIS. Can I interject a comment there? In the east, in the acid deposition, about two-thirds of that is sulfuric acid, about a third nitric acid, so the acid deposition is about two-thirds sulfur and one-third nitrogen.

In terms of visibility in the East, as I stated, about 55 percent of the visibility reduction is sulfur. Nitrogen accounts for about, oh, 5 to 10 percent. That comes from nitrates and NO_2, which are fairly low in nonurban areas.

Now in the West in terms of the acid deposition, it seems like the balance swings a little bit more to the nitrogen. Nitrogen oxide might contribute more than half of the acid deposition in the West, and sulfur oxide less than half, but still in terms of visibility sulfur is a lot more important than nitrogen. That is because the nitrogen compounds that cause acid deposition are mostly a nitric acid which is a gas.

It is invisible. NO_2 has some effect on visibility, source significance in powerplant plumes, but on a regional haze in O2S, very small. In the West unless you are Los Angeles, nonurban parts of the West in the Rocky Mountain region in O2 nitrates are 5 to 10 percent of visibility reductions but sulfates are still pretty big.

Mr. VENTO. Even though they are there in a great percentage the thing that is interfering with visibilities is still the sulfates, by and large, in the open areas, other than the urban areas. You put a qualification. We have Dr. Latimer to enter in the conversation.

Mr. LATIMER. I just wanted to interject that our recent study of haze in the Southwest suggested about 50 to 60 percent of manmade haze was sulfate, and maybe something like 15 to 20 percent of manmade haze is nitrate, so by far sulfate is still the largest contributor in the Southwest as well as the East.

Mr. VENTO. So sulfates are the big problem, and of course, some of this is naturally occurring. Some of the sulfates are naturally occurring. Other products are naturally occurring, wind blown alkaline, so forth, and so on. And that is a factor here, is it not, Doctor?

Mr. LATIMER. Yes. Our study really concentrated on the manmade fraction of haze in the West, and we find that in the clean areas like the Grand Canyon, about two-thirds of the total extension or light extension is due to natural phenomenon like blue sky scatter, wind blown dust and emissions from vegetation.

The remaining one-third, 50 to 60 percent is sulfate and 10 to 20 percent nitrate.

Mr. VENTO. I read someplace, I guess it was in the study that was presented to us today, the World Research Institute study about the volcanos. Do you have any comment about volcanos? Mount St. Helen was a significant phenomenon, a shortlived phenomenon, but there are volcanos that are fairly active on the Pacific rim. Do you have any comments with regards to whether they are contributing significantly here?

Mr. TRIJONIS. Natural emissions are often very important on a worldwide scale, but when you are talking of continental scale, especially in the Eastern United States, I wanted to make this point before, when I heard the thought of natural sulfates brought up in the Eastern United States.

I publish a paper and there have been several other studies published. Based on those, we can be fairly conclusive that of the sulfates in the Eastern United States, only about 10 percent is natural.

Mr. VENTO. In the Eastern?

Mr. TRIJONIS. In the Eastern United States.

Mr. VENTO. In the Western?

Mr. TRIJONIS. The Western there hasn't been as definitive studies of that but I think we can make a pretty good educated guess that in the Western it is more like maybe 10 to 20 percent natural, the sulfates themselves. There are other factors that are more important naturally in the West, the wind blown dust, and because the air is so clean the blue sky scatter is relatively more important but sulfates itself slightly more in the East and may be greater because it is so low in the West.

Mr. VENTO. Let me recognize my colleague, the gentleman from Utah. You see Salt Lake City has been contributing.

Mr. HANSEN. I recognize that, Mr. Chairman. I was just going to tell him about Denver. Thank you.

I appreciate the statements you gentleman have made. I appreciate the goals that you have in mind. This last comment was quite intriguing that you brought up regarding volcanos. Is that what it was, the volcano eruptions, Mount St. Helen and others, one in Mexico and other areas? Did you state that possibly that was a small part of the national scene, 10 to 15 percent?

Mr. TRIJONIS. The natural sulfur oxide, some of that comes from volcanos. Some also comes from vegetation, vegetative processes. Overall on a worldwide scale, it is significant, but in the Northeast United States, on an average it is insignificant.

What happened with Mount St. Helen, the big visible thing you had here was not sulfur oxide. It was just ash, particles being blown out. Even on that on a worldwide scale at times that is fairly significant, but on a day-to-day basis in the United States except for the few days it was really erupting it is not really important.

Mr. HANSEN. At the beginning of this hearing we were discussing things coming from Canada and Mexico, prevailing winds going from the west to the east, that type of thing.

How important is it? Where do we find this problem? Do we find that something that happens in St. Louis, MO, has an effect on you folks in Colorado, some of it on you folks in the Western States? Is that a problem?

In other words what I am really getting at is the question that, Dr. Lents, when he was talking about approaching it on a regional basis which seems to me to be a more logical and regional approach to this thing.

However, you can't accept that premise if you accept the first idea brought up in this discussion that what you do in New Jersey has a direct effect on California. I think some of my first questions would be, would the close areas be the ones that would have the problems? Say you have Salt Lake, you mentioned on the western slope of Colorado because of a problem over there. We have got to do it on a regional basis and take a look at the whole thing? Is that the assumption?

Mr. LENTS. That is my feeling. Again, if we go back to some of the studies I have looked at, over half of the visibility degradation in western Colorado is due to out of State sources. They would vary from sources in Arizona, Utah, California, Oregon, and Washington.

Mr. HANSEN. Excuse me, if I may, but you specifically mentioned on page 3 Salt Lake and Los Angeles were your two largest contributors on the west slope.

Mr. LENTS. From the single urban viewpoint; yes.

Mr. HANSEN. I guess it would be almost impossible to narrow that down. And as you said in your testimony in response to the chairman, there is no single source. Something might contribute a half percent so it is hard to pin it down so you have to take it in the aggregate as you have in this one page, saying 56 percent is industrial sources down to 1-percent residential.

I am curious, if I may pick up on this same line of reasoning and go to the last page, page 7, where the conclusions "I would suggest that Congress consider the following two recommendations."

Mr. LENTS. Right.

Mr. HANSEN. On your recommendation A in the last sentence you say this. "Once a State" and the preliminary I am sure you are aware, "adopts standards for five areas the process should be established to prohibit other States from violating the selected limits in another State." Wouldn't you admit that is a rather difficult thing to do?

Mr. LENTS. I agree it is a rather difficult thing to do. I don't believe it is totally impossible, if a State is willing to make sacrifices in its own State, then we raise the question should an adjacent State or two States ever be allowed to not make any sacrifices that impact the States?

Mr. HANSEN. In theory I couldn't agree more. I think it is kind of like tort law. The one who creates it should pay for it, but I hope that doesn't turn out to be the lawyers retirement bill in 1985, and I mean that very respectfully. Here we are trying to pin down the approximate cause of the pollution, which is extremely difficult. I think the theory makes a lot of sense. I compliment you for that.

If I may, Mr. Trijonis, in your comment you showed some very interesting photographs. I assume they are photographs, or are they computerized photographs?

Mr. TRIJONIS. These are actual photographs, not computerized.

Mr. HANSEN. Were they taken at the same time?

Mr. TRIJONIS. No, they were taken on different days.

Mr. HANSEN. Excuse me. I mean by that at 4 o'clock in the afternoon was one taken, and then as the situation changed was the next one taken at 4 o'clock in the afternoon, or was it taken in the morning?

Mr. TRIJONIS. We try to get photographs like that. We couldn't always do that, so we try to control for Sun angle, because that can be important. In some cases they weren't taken at the same time, but as I remember, in those cases we actually measured the visual range from the contrast on the photographs, so that by saying there was such and such change in the visual range we are actually measuring that from the photograph itself so we won't run into the problem, it really obviates the problem of there being different Sun angles at different times causing different contrasts.

Mr. **Hansen**. In no way am I trying to attack your photographs and I appreciate your bringing them. I am just pointing out to the committee that you can take a picture at 8 o'clock in the morning and take it again at noon and take it again in the evening and you will have three different pictures even though possibly the particles in the air haven't changed very much.

I was just curious if they were all taken at the same time. I appreciate your comments, gentlemen.

Mr. Chairman, I yield back the time.

Mr. **Vento**. This is something that I think should be emphasized, because when you take these, we have to assume that they are taken in an objective manner to provide a representation of the problems that are occurring, and obviously whether it is water vapor, whether it is sulfates, whether it is particulate matter, you are demonstrating that there is something in the air there with similar light conditions at similar times during the day, you don't take one when it's raining and another when it's not. Obviously that would destroy the validity of that type of information in any case.

I have just one more question. Mr. Latimer, you have done a pretty good job I think in terms of talking about some of the economic impact on page 3 regarding the economic benefits gained with visibility improvements. Could you expand a little bit on that? In your testimony on page 3 you talk a little about that. I am just wondering if you would like to expand on that or not?

Mr. **Latimer**. We did a study for EPA a year or two ago in which we looked at various acid rain programs that Congress was considering at that time and we looked at the effects of SO_2 controls——

Mr. **Vento**. Go ahead.

Mr. **Latimer** [continuing]. We studied the effects of SO_2 controls not only in places like the Great Smokies and Adirondacks, but also on regional visibility and as part of that study we worked with some economists who specialized in the area of visibility and they have asked people what they would be willing to pay for improvements in visibility like you see here in urban areas.

And the general average of the willingness to pay is something like 2 cents per day per person for a 10-percent increase in visibility.

So if you multiply those sort of willingness to pay over a year times 150 million people living in the East, you get numbers like $2 billion per year visibility benefit over that period.

Mr. **Vento**. A lot of people are paying more than 2 cents a day if they are building a home at the lakeshore in terms of what they pay for lots or even on a seashore when they want to build. You know what the prices of real estate there are. I suppose one might relate that value to what they are willing to pay in order to get a scenic vista to look out on.

Mr. **Latimer**. There have been studies using the property values and they show visibility is valued quite highly in this country.

Mr. **Vento**. I would think so.

Have any of you projected the level of sulfur emissions for the future, whether they will increase or decrease based on the present patterns, based on present law, I guess? We hear comments about the fact it is deteriorating in terms of visibility in the West based on present law. Within the East most of this is within the context of the law, I guess, with respect to Shenandoah and with respect to other parks.

Mr. LATIMER. In our study in the East we found with no controls, with business as usual in the East, I think SO_2 emissions would increase like 5 percent between 1980 and 1995. In the West we found that emissions would stay constant between 1980 and 1995 pretty much. But for all the significant decreases in smelter SO_2 emissions in the country, those decreases would be almost totally offset by the Mexican smelter increases.

Mr. VENTO. Even though there may be some improvement domestically, the fear of foreign produced smelting and so forth might actually increase or eat up any type of gains we might make here.

Mr. LATIMER. That is right.

Mr. VENTO. I hesitated throughout this hearing on that, but this issue keeps coming back with respect to the Mexican smelter. I am afraid, I fear it because I guess we can say that on a positive basis we would like to see action occur and some international policy accomplished, but it is really very cumbersome to address that. We can talk about it but it is very tough.

The only thing we can control is what we do ourselves, and hope that our policies working with the Canadians and Mexicans would accomplish something that would be beneficial to the overall program. Some sort of agreement.

So we will have to work on that very hard, because there tends to be a tendency to run off and say well, they are not taking care of what is happening on the other side there, what the heck is the use of what we are doing? I think that would be a big mistake, wouldn't it? Don't you agree, Mr. Latimer?

Mr. LATIMER. I think that is right.

Mr. VENTO. Any other comments from the panel? If not, gentlemen, you have done a very good job to introduce the subcommittee to the visibility problems we are experiencing. You have been patient. We appreciate your coming back this afternoon to testify.

Thank you very much.

Mr. VENTO. The final witness today is Mr. J. Robert White, vice president of the Valley National Bank in Arizona, and chairman of the Western Regional Council on Clean Air, and he is accompanied by Dr. Edward Haase of Phelps Dodge Corp.

Mr. White, welcome.

[Prepared statement of J. Robert White may be found in app. I.]

Mr. VENTO. Thank you for being so patient. These hearings tend to go on, but I hope that you have enjoyed the hearing as much as I and other members of the committee.

But your entire statement will be made part of the record, Mr. White, and you may proceed to summarize if you choose.

Mr. White.

STATEMENT OF J. ROBERT WHITE, VICE PRESIDENT, VALLEY NATIONAL BANK, ARIZONA, AND CHAIRMAN, WESTERN REGIONAL COUNCIL CLEAN AIR COMMITTEE, ACCOMPANIED BY EDWARD HAASE, PHELPS DODGE CORP.

Mr. WHITE. Thank you, Mr. Chairman.

We, too, have enjoyed the proceedings through the day and found them extremely informative from all the presentors.

Mr. Chairman and members of the subcommittee, I am Robert White, vice president of the Valley National Bank of Arizona, and chairman, speaking to you as chairman of the Clean Air Committee of the Western Regional Council.

Appearing with me is Mr. Ed Haase, senior environmental analyst for the Phelps Dodge Corp.

The Western Regional Council, or WRC as I refer to it, is an organization of 40 companies engaged in the broad variety of business activities in the West, including financial, mining, utility, transportation, accounting, energy, and others.

The WRC has always focused its attention on issues where there is as we see it, a unique western consideration, or difference.

Therefore, my comments will not be addressing the clean air issue of the East but those as we see them from a western perspective.

Air quality in our national parks in the West is of particular interest of the WRC because as you well know, a significant number of our largest parks in the Nation are located in the West. They are dear to us. We appreciate this opportunity to share our western perspective at this hearing.

As you have suggested, we have submitted a detailed statement to the subcommittee. For the sake of time, I would like to briefly summarize only those major issues in that statement.

Mr. VENTO. Certainly, Mr. White. That is entirely appropriate.

Mr. WHITE. Thank you.

First, recent research and scientific data conclude that significant improvements have indeed been achieved in air quality in the West. Air quality in the West, including in our national parks, will continue to improve. According to figures in the World Resources Institute, which you heard from this morning, their report, present day anthropogenic sulfur emissions in the 11 Western States are actually lower than they were 35 years ago. Considering the extraordinary growth in the West since 1930, that is I believe a major achievement.

Sulfur emissions between now and the year 2000 are projected to decrease even further.

The EPA air quality and emissions trends report released earlier this month concludes that the Nation's air is far cleaner today than it was 8 years ago. Sulfur dioxide, ambient air quality levels, improved 36 percent. Sulfur oxide emissions improved 19 percent. Ambient particulate levels 20 percent.

Improvements were documented in EPA regions that include the major national parks in the West. A report commissioned by the State of New Mexico cited the SO_x emissions will soon be down to the level of 1940's and TSP emissions only a fraction of the early 1940's level.

These are only a few of the reports and studies documenting western air quality improvements. Then why the improvements you might ask? We feel the installation of constant emission controls on smelters and nonferrous metals industry has spent nearly $1.5 billion on air pollution controls.

Further, constant emission controls and the burning of low-sulfur western coal by coal-burning powerplants, incidentally such plants in the 11 Western States account for less than 3 percent of all the U.S. powerplant emissions.

Second point, while there is still insufficient research on acid deposition in the West, scientists and researchers are now focusing significant efforts in our region. Numerous studies are currently under way by Government at all levels, industry, academia, and others. It is very important, however, to assess the actual research data rather than the media or report summary conclusions.

For example, much attention was focused on preliminary assertions of acid deposition damage to forests near Gothic, CO. However, scientists in a subsequent EPA supported investigation of those assertions were unanimous that there was no evidence that atmospheric deposition was contributing to forest damage.

Despite the statements and new releases and articles and other reports about acid deposition damage to parks and other resources in the West, there is in fact no valid scientific evidence documenting acidic deposition damage anywhere in the West.

Separate studies provide some additional interesting data in this area. I will mention the Arizona clean lakes classification study in my own State, showing that no sampled Arizona lakes were below the critical alkalinity sensitivity level despite higher SO_2 emissions of past years.

Another study in 1984 by Ashbaugh in the Atmospheric Environment Journal indicated that sulfur emission products in the southern Rocky Mountains are not transported in significant amounts to the northern Rockies, the location of several national parks.

I found it interesting this morning to hear Dr. El-Ashry mention the Arizona smelters and the western slopes of the Rockies, and the winds in that area that would have to travel just a little to the west which is possible at low levels, but it is almost directly, the smelters in Arizona as due south of the western slopes of the Rockies.

With most of the prevailing winds that would be difficult.

According to the WRI report, potentially significant ecosystems such as are found in parks are not located near highest sulfur and nitrogen deposition in the West.

A recent SGS study analyzing stream chemistry indicated that Southwest SO_2 emissions apparently do not measurably affect Colorado stream chemistry. I cite those as data that is now available.

These other efforts support the conclusion of no significant acid rain damage.

While this is an oversight hearing, the formal hearing news release urged congressional consideration of clean air legislation, consequently we have included detailed discussion of our positions on acid rain legislation and visibility provisions in our written statement.

Let me briefly summarize those.

We sincerely hope, if Congress considers legislation to improve controls to reduce acid precipitation, that regional variations and State flexibility will be taken into account in initial control efforts to be applied to both stationary and mobile sources in regions where significant acid precipitation problems exist, or damage has occurred.

Sources should be permitted to use the most cost-effective means of achieving emission reductions. Future emission reductions should be implemented in a program of several phases and should be defined in response to research results.

Costs of emission reductions should not be spread beyond the source through a national tax. Finally, we believe caps should not be imposed.

Regarding visibility, we enthusiastically support protecting visibility in our very special national parks. However, there is not currently a sufficient understanding of visibility impairment attributable to manmade pollution sources to develop a coherent regulatory program. Both monitoring and modeling today is inadequate.

In establishing the visibility program, in 1977, Congress understood the need to limit it to within certain class 1 areas. However, EPA went beyond the expressed intent by seeking to regulate integral vessels or areas of land outside, but visible from within class 1 areas.

The visibility issue has its greatest impact in the West, which has 120 of the 180 proposed National Park Service integral vistas. The WRC opposes integral vista concepts.

In conclusion, we sincerely appreciate the opportunity to appear before you and present our western perspective, and we would be pleased to answer any questions of a technical nature. Dr. Haase is here to assist in that.

Mr. VENTO. I thank you.

I wear two hats, I serve on the Banking Committee as well, so——

Mr. WHITE. I know that very well, Mr. Vento. I am very aware of that.

Mr. VENTO [continuing]. I admire the tact of someone who has to work on banking-related issues and also on land use issues such as we have been focusing on, because we are talking about parks and impact of air pollution on parks. We are talking about other issues that are somewhat different today. It is hard to focus only on those, because as you notice throughout the day I have tried to get Members back to look at the parks and look at the effect of land use, and so on.

Let me start with the conclusion. I find your statement useful and obviously I think that you agree with some things that are in the World Research Institute study, the Western focus is good. I think it points out good things and I think it points out some potential problems, at least it gives us a better picture than we have had.

It is a better picture of what occurs there. From there we may draw different conclusions about what policy path to proceed on, but nevertheless it is a sound conntribution, I hope you agree to the study and to those interested in crafting policy.

Let me start with the fourth point you made. I guess this is—maybe I am getting into a swamp on this integral vista matter, but I have a hard time trying to understand just practically—I don't think it takes a great scientific explanation—of how you separate what is going on. In other words, we are talking about class 1 areas. You say visibility protection provisions should be applied to effects only within such mandatory class 1 Federal areas. The concept of integral vistas should be repudiated.

Don't you agree that within those classic class 1 areas, those national parks and wilderness area, that the visibility, scenic vista, ought to be preserved? Don't you agree with that?

Mr. White. I believe, Mr. Chairman, that visibility within should be preserved and protected. Maybe I can use an illustration from my own State.

Mr. Vento. You know, the dilemma I am coming to it seems is how do you do it? Do you put up a barrier at the park and not let any air in from outside, because clearly that is what we are dealing with here in terms of trying to view this, say the Grand Canyon or other great area, Capital Reef or Canyon lands from my colleague's State.

Mr. White. Using one illustration as we perceive the potential hazard of the outside versus inside, we have one peak in my State that as a boy I went to, Aztec Point. It is about in the middle of the State nearly. You get on top of Aztec Peak and I can see in Mexico, California, Utah, New Mexico. If we had integral vista protection from there, we could wipe out the rest of the State almost using that as an illustration.

Mr. Vento. In terms of——

Mr. White. Looking beyond the class 1 area.

Mr. Vento. I see your point.

Mr. White. That would do away with communities, towns, industries, all kinds of things.

Mr. Vento. I guess it is a question of what the value is and what the cost is in improving that. You point out an absolute reduction in terms of sulfur dioxide emissions in the last 10 years or so. Nevertheless you heard the testimony here today where they say that 75 percent of the—I don't know if it was Utah or Colorado but a significant number are under no restrictions at all because there is so much clean air they don't have to worry about it.

Mr. White. From earlier testimony, yes.

Mr. Vento. Do you agree with that?

Mr. White. May I ask Mr. Haase to comment?

Mr. Vento. Sure, we would be happy to have his testimony. I guess I introduced you for the record, Mr. Haase.

Mr. Haase. Yes, thank you.

Yes, I could comment on that. I think all we can look at in the West if we are talking about the region are total emissions. Total sulfur dioxide emissions have gone down significantly since 1970.

Mr. Vento. Does that mean smelters are closing? That is one of the phenomenon that would give you a net gain.

Mr. Haase. Between 1970–80 it was due to constant controls on the smelters. In Arizona the reduction in SO emissions between 1970–80 was about 1,400,000 tons of SO. Since that time there have been additional reductions and some of those have been due to additional constant controls, some have been due to temporary or permanent closures of smelters.

Mr. VENTO. I notice that your testimony today, Mr. White, agrees very often with the World Resource Institute study. Do you also agree with the fact that they are talking about some of these mountain tops and areas where there is little buffering capacity, do you agree that these are high risk type of environments in terms of acid deposition or not?

Mr. WHITE. We have not found that to be the case in our review of the same material. Again I would like Mr. Haase to comment.

Mr. HAASE. I guess I might cite Dr. Turk from the U.S. Geological Survey who published a paper and it was he who actually identified many of the lakes in northern Colorado that were identified as vulnerable or sensitive.

Mr. VENTO. Do you agree with this conclusion?

Mr. HAASE. Yes, I was just going to state what his conclusions were. He qualified it in this sense, he said they are potentially sensitive and they would be sensitive if acid rain or acidic deposition was like it was in the East which it is not. So until the acidic deposition, according to his interpretation, is or would be as bad as it was in the East, these are not sensitive areas.

Mr. VENTO. Some of the testimony I have had here seems to imply that since you have reduced the amount of NO_x and sulfur dioxide that somehow that is something that puts you off by yourself. But you are not. What you get in NO_x and other pollution from air may come from Mexico, or Minnesota or California, they may come from other areas.

That is one factor.

Then of course, the other is that you disagree that there is a cumulative effect here in terms of the amount of emissions being—most of them are in terms of NO_x and sulfur dioxide are manmade. They are not something that have been there for hundreds of years. It is something really that occurred in the last 70 years in the West.

Mr. HAASE. Yes, that is true.

Mr. VENTO. It is true they are manmade, true they are cumulative. Maybe I would like you to address both of those points.

Mr. HAASE. Some of them are made by man in the East and West.

Mr. VENTO. Seventy-five percent in the West are manmade, do you disagree with that statement?

Mr. HAASE. No, I don't disagree with that.

Mr. VENTO. OK.

Mr. HAASE. Would you again ask the question?

Mr. VENTO. I think I had a question about whether they are manmade and I am sorry if I distracted you. The other is whether they have a cumulative effect.

Mr. HAASE. OK.

There are really no data on which to make that judgment. Again from 1970 to the present time sulfur dioxide emissions in the West have been reduced considerably. We are not aware of any damage that has occurred even when these emissions were higher, and now they are considerably lower.

Mr. **Vento**. Except you agree, I asked about the environment and Mr. White referred to you about mountain top areas and you referred to Mr. Turk's work and I am not intimately familiar with it, but the point is that I expect there is a limit to the capacity even if there is significant ability to neutralize these acids in terms of alkaline substances in the West. I think you would agree that an igneous metamorphic mountain structure doesn't have a great capacity to neutralize acids?

Mr. **Haase**. There is no scientific indication that there is any threshold that has been reached.

Mr. **Vento**. There is no capacity, though, Mr. Haase, there is no capacity in igneous rock. Are there any carbonate structures in igneous rocks? We are not talking about limestone. This is igneous and metamorphic rocks.

Mr. **Haase**. Well, rocks are one point of consideration. The other——

Mr. **Vento**. Well, soil.

Mr. **Haase** [continuing]. The other considerations are soils. The table from the World Resources Institute which you have referred to shows that sensitive soils don't occur in Colorado for the most part. They do occur in the Cascades area up in the Pacific Northwest.

So again scientifically there are really no data that support that or the contention that there is a cumulative problem going on in Colorado. Undoubtedly if the acidic deposition were increased that has to be come point where alkalinity would be reduced significantly.

Is it occurring? There is no evidence of it now. I cannot say that it isn't. Obviously more data would be required to come to that judgment.

Mr. **Vento**. I think all of us could agree that we want to pursue more information, more data on this. Obviously if we recognized the fact that a significant amount of sulfur dioxide and nitrous oxide is man made in the environment in the West and East, I think obviously it does accumulate.

Are you concerned about the lack of dry deposition monitoring in the West, Mr. Haase?

Mr. **Haase**. Yes; there is a concern with lack of dry deposition monitoring everywhere. Nobody really knows how to measure it. That is one of the problems.

Mr. **Vento**. It is more of a phenomena in the West and East, isn't it?

Mr. **Haase**. It appears to be along with acid deposition, dry monitoring of acidic materials would also be dry deposition of basic materials.

Mr. **Vento**. Yes. From air substances; yes.

Mr. **Haase**. We don't know what the total effect of that is.

Mr. **Vento**. Do you agree with the conclusion that in some areas that dry deposition may be as high as 15 to 1 in California?

Mr. **Haase**. I have no idea. I have no data to show that is wrong but I don't know either way.

Mr. **Vento**. There is some information on that that was reported on by the WRI and the fact is 1 to 1, is in the East, do you disagree. You think that is valid?

Mr. **Haase**. Do I disagree with that?

Mr. **Vento**. Do you think it is valid, do you disagree, are you concerned about that?

Mr. **Haase**. I don't disagree with it. No, sir.

Mr. **Vento**. Good.

Let's call on my colleague from Utah.

Mr. **Hansen**. Thank you, Mr. Chairman.

Mr. White, Mr. Haase, I appreciate your testimony. It was excellent. I guess I could draw conclusions from what you said there, precipitation acidity increasing or not, you made it clear in your mind from the past to the present it is really decreased; is that correct?

Mr. **Haase**. Yes; it has.

Mr. **Hansen**. I would draw from the panel that was there who made a statement, I don't know if I have it straight, the West has a different problem than the East regarding the fact they don't have as dirty a material.

I cannot accept the premise that the West has to put on the same scrubbers and type of things that are required on their coal-fired electrical generating plants and other plants as in the East.

Is that a correct statement? Utah Power & Light seems to think it is because every time they ask for an increase in power rates in the State of Utah, they use that as an example and they stand up to the public service commission, where my last AA is now one of the commissioners—I lost him to those guys—and moan about the idea that they have to put on the same type of scrubbers and if they didn't have to burn their "rotten" tongue-in-cheek, coal that comes from Tennessee, Kentucky, and Missouri, they wouldn't have to do that. And one of our past Secretaries of the Interior lamented the West has to pay to take the coal that is in the East and put it in the West.

Did I miss all that or is that all correct coming from our utilities in the West? In other words, do they have to put with the same requirements as the East when they don't have the problem?

Mr. **Haase**. Yes; to the best of my knowledge utilities in the West also have to put on the same scrubbers that the East do even though they burn low-sulfur coal.

Mr. **Hansen**. In a deposition they made the statement that they have to test their scrubbers with sulfur that they have to throw into the thing in some way to check them out and see if they work because the type of fuel they burn doesn't have enough sulfur in it to check it.

So I assume that your assumption that it went down from the 1970's to the 1980's could be predicated on the requirements that don't apply but are so stringent?

Mr. **Haase**. Yes; it went down for two reasons, for one reason the smelters put on permanent constant controls, copper smelters; and the second reason is the one you just mentioned, that any new powerplants that went on line were subject to very strict sulfur dioxide emission requirements.

Mr. **Hansen**. One of the things about lichens came up in this hearing. Is it true that the high elevation lakes in northern Colorado and Wyoming are downwind from sulfur dioxide emissions in southern Arizona, for example?

Mr. **Haase**. Again there is not a great deal of data available on that. But if we look at upper airwinds, the prevailing winds in the Arizona area, from Arizona—where emissions occur in Arizona are generally from the northwest to the southeast or from west to east for over half the year. For the other half of the year, they are from southwest to northeast or east. Now these are prevailing winds. So at no season of the year do those upper airwinds up to 3,000 meters blow from south to north. That doesn't mean they never blow from south to north, but the prevailing winds for no season are in that direction.

Mr. **Hansen**. Does the acidity increase with altitude in the mountains? Would you respond to that?

Mr. **Haase**. That contention has been made. I am not aware of any valid precipitation monitoring data that really backs that up.

There is a small amount of recent data produced by the National Atmospheric Deposition Program—this is reported in the Gothic study on health of trees that Mr. White mentioned—that indicates based on some NADP data in wilderness areas up in northwestern Colorado, that higher elevations in Colorado are not more acidic. But that is another area where obviously more monitoring data would be necessary.

Mr. **Hansen**. Is precipitation in the U.S. acidic enough to potentially damage the ecosystems in your opinion?

Mr. **Haase**. Again, Mr. Hansen, at this point it doesn't appear that it is.

With the scenarios that we have it is not going to get more acidic. The World Resources Institute report again if one looks at the figures, illustrations in there, indicates that sulfur dioxide emissions between—we have heard they have gone down from 1970–80 and it is reported in there, from 1980 until the year 2000 they will be even less. This means that in the year 2000 sulfur dioxide emissions in the 11 Western States will be less than they were a half century earlier, in 1950.

So there is no evidence to this point that there has been damage in the past and if at least in terms of sulfur oxides, if deposition will be less in the future, one wouldn't think there would be but again here is an area where we obviously need more research.

The research in the West has not been nearly as extensive as in the East.

Mr. **Hansen**. During this hearing we have had a lot of people allude to the idea of where it comes from, whether that is the reason for the hearing or not. I would like to explore it for a moment, though.

For all of us old has-been pilots, we know that generally prevailing winds go west to east.

We know if you fly from here to the coast you will be a lot longer than if you fly the other way.

There was a study done at one time that, 1981 as I remember, if you dropped atomic bombs on California, for example, where does the fallout go? It generally goes to the east. By the time it reaches the Mississippi River, according to the study, it is merged together and everybody from that point gets fallout.

The other thing it said is along the way it drops particulates down until pretty soon it fades out and there is nothing more that is lethal. Wouldn't the same be true in anything, coal-fired electric generating plants, anything that would put pollutants in the air? Wouldn't it stand to reason that further from the base where it starts, the less amount of particulates it would drop, the further out it gets?

Mr. HAASE. That is getting away from the area of expertise that is mine, but I think one of the scientists this morning made that very point.

Mr. HANSEN. So it would be somewhat difficult to take something from Panama or from Mexico or Alaska or Phoenix or Salt Lake and pin that on to something in St. Louis?

Mr. HAASE. Yes.

Mr. HANSEN. Do you feel that is a correct premise?

Mr. HAASE. That it would be very difficult to do that, yes.

Mr. HANSEN. In other words, you could measure in degrees the closer it was to get a larger amount of pollutants to where it started from, the genesis. Isn't that a logical assumption?

Mr. HAASE. That is logical and of course the problem is there are other sources in between which would add to it.

Mr. HANSEN. I agree, would add to it, yes.

Thank you, Mr. Chairman.

Mr. VENTO. Thank you, Mr. Hansen.

I would just point out that we are going to continue with the hearings. We are going to have come before us park superintendants from Sequoia National Park in the West, Santa Monica Mountains, Sugaro in New Mexico and other park units. All 225 Ponderosa pines studied in 1984 showed some ozone injury. I know you are talking about sulfur dioxide and nitrous oxide but we heard the explanation of ozone as being another substance that is closely associated with nitrous oxide emissions.

There is a long chemical formula which I cannot develop, and I couldn't get a Ph.D. to do it, or maybe Dr. Haase, you could do it if you want to. But I just want to say that the issue is not resolved with respect to this study. The WRI study did not point out that injury.

Incidentally, that study does go on to say that while there has been declines in SO_2 and nitrous oxide acidification which are the source of the problems, that indeed that after 1990 those will start going up again and that of course is just dealing with the emissions from those 11 Western States that are undertaking the study.

It doesn't deal with what Mexico might do, what Canada might do, it doesn't deal with what other Midwest areas may do in all those prevailing winds from west to east—and I am not an old pilot—but I am familiar with wind and weather patterns that can transport these substances literally thousands of miles.

It might be from Canada and I don't want to beat up on the Canadians any more than the Mexicans, we have to get along with them in terms of these issues, but there are a lot of ways that this gets introduced. There are areas in my judgment and I think in others that are more sensitive. I think we can say that without necessarily saying we are being damaged, but potentially the cumulative effect of this is damaging if we have a phenomenon going on in terms of producing more of this now than in past history; it is a problem that has to be solved.

How much the effort is, what the cost is, you heard the description of the American Association of Architects and from plant pathologists and we will hear from the park folks tomorrow about the damage that is going on in the parks, the visibility problems that are attendant, and we hope that we can establish a good record here and then make good policy based on that particular record.

So we appreciate, gentlemen, your contribution, Mr. White, and Mr. Haase, this afternoon.

Thank you very much.

Mr. **White**. Thank you, Mr. Chairman, thank you.

Mr. **Vento**. The meeting will stand adjourned until 9:45 in the morning to continue this oversight hearing.

[Whereupon, at 4:03 p.m., the subcommittee was adjourned, to reconvene on Tuesday, May 21, 1985, at 9:45 a.m.]

IMPACTS OF AIR POLLUTION ON NATIONAL PARK UNITS

TUESDAY, MAY 21, 1985

House of Representatives,
Subcommittee on National Parks and Recreation,
Committee on Interior and Insular Affairs,
Washington, DC.

The subcommittee met, pursuant to recess, at 9:55 a.m., in room 1324, Longworth House Office Building, Hon. Bruce F. Vento (chairman of the subcommittee) presiding.

Mr. Vento. The subcommittee on National Parks and Recreation will be in order.

Yesterday's hearings, I think, went very well. I hope that others gained insights, as I did. Today will, I am sure, prove to be another interesting revelation in terms of problems that we are experiencing with respect to our national parks.

There are few times that we can act with complete knowledge and certainty. We have heard specific examples of resource damage to our parks and recreational areas. The response to them seems to often be more study.

I would like to submit for the record a statement regarding the Boundary Waters Canoe Area Wilderness and the Voyageurs National Park in Minnesota, which is on the edge of the Canadian shield. The rock formation there has very little buffering capacity.

[Editor's note.—The above-mentioned statement may be found in appendix II. See table of contents for page number.]

Mr. Vento. These national conservational units, such as the Boundary Waters Canoe Area and Acadia in Maine, are examples in the long list of those areas where all the efforts are focused on study but with little consideration of the actual resource damage and mitigation programs.

I am extremely pleased this morning to note the presence of Senator Mitchell of Maine and his willingness to participate in this hearing. We will be hearing from Senator Baucus later, a former House Member and friend. Both of them, I am sure, are going to provide us with valued insights, Senator Mitchell especially, working on the committee in the Senate that has primary jurisdiction dealing with many of these topics, with Senator Stafford. Senator Mitchell has been a singularly clear voice with regard to dealing with the problems of air pollution.

Senator, I am very pleased with your work. I am very proud of your work, as I am sure are your constituents. It is a privilege and honor to have you present to address the subject of air pollution in our national parks. Senator Mitchell.

[Prepared statement of Hon. George J. Mitchell may be found in app. II.]

STATEMENT OF HON. GEORGE J. MITCHELL, A U.S. SENATOR FROM THE STATE OF MAINE

Mr. **Mitchell.** Thank you very much, Mr. Chairman and members of the committee. I appreciate the opportunity to testify before your subcommittee today on a subject of great interest to me, the effects of air pollution on Acadia National Park in Maine.

Before I begin my testimony on the subject of air pollution, I would like, Mr. Chairman, with your permission, to briefly digress and express my strong support for Acadia Park legislation which is pending before this subcommittee. S. 720, which I introduced with my Senate colleague, Senator Cohen, and H.R. 1685, which Representatives Snowe and McKernan have introduced here in the House, would establish congressionally mandated boundaries for the Acadia National Park. The need for this legislation arises from a historic fact which has resulted in decades of controversy. Acadia was created by private donations of land in the early years of this century. Its charter, while authorizing further expansion of the park through donation, does not authorize acquisition of land through purchase. This combination, the inability to purchase desirable land for inclusion in the park, and the ability to accept donations with little constraint, poorly serves both the interest of local towns and residents and the preservation of the park's unique resources.

The legislation before this subcommittee would rectify this problem, and I hope that you will give the bill your attention and support.

Mr. **Vento.** Senator, I want to assure you, if I may interrupt you at that point, that we will. I, in fact, am planning on a field inspection in July and want to coordinate that with you so that you have input and knowledge of my personal visit to that field inspection.

Mr. **Mitchell.** Well, you couldn't have picked a nicer time of year, Mr. Chairman, to go to Acadia National Park.

Mr. **Vento.** Well, it's tough work, but somebody has to do it, Senator.

Mr. **Mitchell.** We're going to see to it that you get a Maine lobster caught right off the shores of Acadia as well.

Acadia was the first national park created east of the Mississippi River. Since 1916 it has been an important natural and recreational resource for State and local residents and for millions of people from other States and nations who enjoy its beauty. In 1984 the Park Service recorded over 4 million visitors to Acadia.

The natural resources of Acadia, its spectacular beauty, and its unique coexistence with fishing villages and towns which were established with the beginnings of European settlement on the North American Continent combine to make the park an experience unlike any other in our Nation.

Acadia is a nesting site for almost 150 bird species. Over 320 bird species have been seen in the park. Just last May, seven peregrine falcons were reintroduced to the park as part of the effort to reestablish a breeding population of this bird on the east coast.

Clearly, Acadia National Park is a national treasure.

Yet, as you heard during yesterday's testimony by Dr. Janet Anderson, there is now evidence of possible negative impacts of acid rain on the waters of the park. A recent study of this problem by the University of Maine and the College of the Atlantic reports that the average ph of rainfall in the park is between 4.3 and 4.5. This is a level more than expected for a coastal area.

Small brooks show the most marked effects of this acidity, especially during the spring snow melt. The study indicates that the largest lakes in the park appear to be in good condition today, but even they may be threatened if acidic precipitation continues unabated. In addition, a number of acid fog events occurred last summer in the area of the park.

High levels of ozone have also been recorded in the park recently. In 1983, on 101 occasions, ozone levels in the park exceeded the State standard of 0.08 parts per million. Ozone levels remained high in 1984, exceeding the State standards 88 times.

The evidence of damage to Acadia from air pollution, particularly acid rain, is just an example of a growing national problem. There can no longer be serious doubt that acid precipitation has damaged our Nation's lakes and streams. In addition, some studies are beginning to indicate that acid rain in combination with other forms of air pollution may be causing forest damage throughout the United States. That is a particular concern to me, Mr. Chairman, because Maine is 91 percent forestland, the highest percentage of any State in the Union, and it is the backbone of our economy.

On January 24 of this year, I reintroduced comprehensive legislation to deal with the problem of acid rain. My bill would require a 10-million-ton reduction in sulfur dioxide emissions in the Eastern United States within 10 years after enactment.

While Congress has failed to act on acid rain legislation so far, the continuing accumulation of scientific knowledge makes me confident that we will eventually have a meaningful acid rain control program. There is no question in my mind as to whether we will act, only a question as to when.

There may be disagreement as to the details of a control strategy. That is understandable and to be expected in dealing with a problem of this magnitude. But further postponement of action on this issue will result in increased environmental damage, a necessarily increased level of control, and, most likely, increased costs.

In conclusion, Mr. Chairman, I am pleased to have had an opportunity to discuss briefly with you the importance of Acadia National Park and to express my concern over increasing evidence of damage to the park from air pollution.

I look forward to working with you and the other members of the subcommittee as you consider this legislation dealing with this problem and legislation to establish a permanent boundary for Acadia National Park.

Mr. VENTO. Thank you, Senator.

Dr. Janet Anderson's testimony yesterday was a very good review of the vegetative effects and some of the aquatic effects in

Acadia. Like the Boundary Waters Canoe Area in northern Minnesota, on the edge of the Canadian shield, we share a geologic and a very similar type of a problem. So, insofar as I am familiar with the Minnesota problem, I understand pretty much what is happening there.

The primary emphasis of the hearings, the new information of the World Resources Institute study, I think, will enable us from this point on to document changes that are occurring.

But primarily, you would agree that the immediate effects in Acadia are both aquatic and vegetative, especially the work that has been done in terms of lichen problems that have been experienced there.

Of course, you are very concerned; 91 percent of Maine is covered by forest resources.

Mr. MITCHELL. That is correct.

Mr. VENTO. And reports we get back from Germany, from the Black Forest, indicate that 50 percent of the various mixed species of deciduous plants are experiencing some degree of damage. Now, this is also, of course, true at Acadia, and primarily it is ozone damage.

Would you like to elaborate on that? Have you personally been on site? The reports with regard to ozone damage are very startling in Acadia and, as a matter of fact, in most of our national parks.

Mr. MITCHELL. That's right. Mr. Chairman, if I may, the evidence of damage by acid precipitation to water resources is, in my judgment, clear and convincing. That alone justifies the need for action now. That is, the resource is so important to our Nation—and it is not just in the Northeastern part of the United States and Canada, it is throughout the Eastern United States and increasingly in the West—that some action is necessary now.

The evidence of damage to forests is not as conclusive, is mixed, and the circumstances are somewhat different because it appears that the damage results from some combination of air pollution. Nonetheless, I think that we must very carefully evaluate the effects on forests and consider that as an additional reason, not the primary reason, but as an additional reason to control acid precipitation which in the Eastern United States, is primarily caused by sulfur dioxide emission.

I hope very much that the Congress will act in this session on that problem, because it affects, as I noted earlier, a very wide area of the United States now and Canada as well.

Mr. VENTO. Senator, in light of the damage that is occurring to our national parks in a host of ways, both culturally, vegetatively, aquatically, do you believe that special protection should be continued for the National Park System and for other public land units or not?

Mr. MITCHELL. Yes, I do, Mr. Chairman, because the one certain thing is that pressure, the demands, and the use of parks will grow. There is no prospect of declining pressure for use of the parks. So, I think, if anything, we have to strengthen the protection that our parks have had.

Mr. VENTO. I agree with you, Senator. I hope we can work with you as the leading advocate in the Senate on air pollution problems. I hope that these hearings will be helpful to you.

Let me call on my colleague, the gentleman from Missouri, Mr. Emerson.

Mr. **Emerson**. No questions.

Mr. **Vento**. The gentleman from Pennsylvania, Mr. Kostmayer.

Mr. **Kostmayer**. Senator, I look forward to visiting your State next month also. It seems unfair to make Chairman Vento go all by himself. So, in order to relieve him of that heavy burden, I will be with him and look forward to being there.

I appreciate your testimony, Senator Mitchell.

Mr. **Mitchell**. Thank you.

And although I have been to Acadia many times, I welcome every opportunity. So, if you will give me a date, I will be there to greet you.

Mr. **Vento**. That would be a great pleasure to be there with you. You do have two lobsters, I hope.

Mr. **Mitchell**. Yes, we do. We might even scratch up four. And if Senator Baucus joins us, we'll make it six.

Mr. **Vento**. Thank you very much, Senator.

The gentleman from California.

Mr. **Pashayan**. Senator, thank you for being here. I am sorry to be late for your testimony. I do not think I have any questions.

Mr. **Vento**. Thank you, Senator.

Senator Baucus is a colleague who worked with us in the House and is one of the leading advocates in the Senate now in dealing with natural resource problems.

Senator, I was struck yesterday by the introduction to your home State, of course, the Big Sky country, and the report from the World Resources Institute which sort of fills in a gap or a void that has existed with regard to baseline data dealing with air quality in our national parks, of course, being the subject here. I don't know if there is any State in the Nation that has the combination of clean air and national parks that Montana happens to be the home of. So, I am very pleased to welcome you here, Senator, and to consider your testimony before the subcommittee today. Welcome to the committee and welcome back to the House.

[Prepared statement of Hon. Max Baucus may be found in app. II.]

STATEMENT OF HON. MAX BAUCUS, A U.S. SENATOR FROM THE STATE OF MONTANA

Mr. **Baucus**. Thank you very much, Mr. Chairman.

I want to praise you for calling these hearings. There is probably no resource treasured as much in our country as the national parks. The national parks are our cathedrals. Among all our national parks, Mr. Chairman, there is a core of parks that I think make up the crown jewels of our National Park System.

I am referring to parks such as Glacier National Park and Yellowstone National Park, Montana, as well as Yosemite, Rocky Mountain, and Cascade National Parks. These parks are world renowned and represent the frontier that has made this country great.

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Each year, millions of visitors travel to these parks to enjoy their serenity, their solitude, their natural splendor and their wildlife. Obviously, they deserve special protection.

The Clean Air Act does this. The national parks are designated class I airsheds. Stringent standards regulate their air quality. These stringent standards are to prevent significant deterioration.

But recently, I have become concerned that these special standards may not be enough. These standards protect against immediate or localized pollutants, but they may not do the job of protecting national parks from pollutants coming from long distances. I am referring, of course, to acid rain.

Acid rain is nothing more than air pollution that travels a long distance. Nitrous oxides form nitric acid. Nitrous oxides also contribute to ozone formation. Sulfur dioxide forms sulfuric acid.

Much of the debate to date has focused on sulfur emissions. Most of the sulfur pollution comes from existing coal-fired powerplants. Sulfur dioxide control is a major problem both in the East, where the problem is severe, and in the West, where continued diligence is needed.

But in the West, other pollutants have been identified. The World Resources Institute, which you mentioned, Mr. Chairman, recently completed a study of acid rain in the West. This study concluded that nitrous oxide emissions were the major concern in the West. This study further concluded that our most vulnerable areas were our national parks and our wilderness areas.

Unlike the East, though, where acid rain is causing serious damage today, there may still be time in the West if we act promptly to avoid potential future serious problems. We, in the West, however, need a different set of approaches and solutions than we now have.

In the West, NO_x is a major concern. Recent reports on acid rain damage in Germany, for example, caused by nitrous oxides underscore the need to do more to control nitrous oxide.

More stringent NO_x controls need to be considered for automobiles, trucks, and for stationary sources.

Our greatest concern in the West about sulfur dioxide pollution is a copper smelter pending in Mexico. This smelter could come online with little or no pollution controls—to repeat, little or no pollution controls—just across the border in Mexico. We obviously need to push for pollution controls on this smelter. It is inappropriate for that smelter to operate and to pollute our States. We also need to reconsider how we are regulating our own copper smelters. For example, the Western Governors Association has recently taken a position opposing the extension of non-ferrous smelter order deadlines. It is time for Congress to reconsider this issue as well.

The New England States have relied on transboundary pollution abatement provisions of the Clean Air Act to address pollution sources in other States. But this has not been successful. Congress needs to take steps to make section 126 of the Clean Air Act workable, or we won't be able to protect national parks. Perhaps we need to look at groups of both mobile and stationary sources rather than looking at a single source, as is currently required in the act.

The Clean Air Act does a good job of controlling pollution from new sources generally. However, percentage reduction requirements are unfair to the West. They have kept emissions low but at a tremendous cost. That has to be reconsidered. At the same time, we need to take a hard look at the current emphasis on new pollution sources. Perhaps existing source standards need to be promulgated.

In addition to the hearing that you will be attending, Mr. Chairman, in the State of Maine, Senator Hart and I are planning field hearings to gather testimony on acid rain in the West. I, of course, invite you and Congressman Kostmayer to come to our hearing in the West as well. We may not have lobsters, but we have other amenities which I think you will find very pleasing.

I hope to hold hearings in Yellowstone, Rocky Mountain National Parks, and perhaps other areas throughout the West to learn more about acid rain in the West.

Again, Mr. Chairman, I commend you for holding these hearings and look forward to working with you to resolve this critical issue.

If there is a time to act to prevent a problem, now is the time.

Mr. VENTO. I think that that is correct. I think obviously this World Resources Institute study which has been done has activated you. It is going to activate all of us with respect to this issue. We have had a great deal of concern in the Midwest with regard to problems there and in the Northeast.

I think that the missing piece in this has been the West, quite frankly, some of these pristine areas, as you characterize properly as the crown jewels of the National Park System. The problems of air pollution show this area really is at risk. There are those who have argued that it is not, but I think that this study very effectively argues that it is at risk with visibility and other problems.

Of course, the issue with regard to the smelter in Mexico is a serious concern and points out the necessity for an international agreement with Mexico similar to the one, I guess, that exists with Canada. I understand that the administration may be embarked on that, but I think that a push may be necessary. This is going to be very difficult to deal with.

I trust that you agree with that.

One of the points that I was not aware of is the Western Governors taking a position opposed to the extension of nonferrous smelter order deadlines, which is of concern. Now, of course, some have indicated the reduction in sulfur dioxide in the West, but the fact of the matter is that I don't think they can make a similar case for the production of nitrous oxide which, of course, is much more serious a problem, as you have indicated.

I wonder if the costs have been measured, the costs of not complying with, for instance, the deadline for nonferrous smelters in the West as compared to the costs of doing so, that is, trying to measure the costs of what the damage would be in terms of the public lands and resources is a great and significant concern. I would say that the visibility problems constitute a very serious problem in the West with regard to sulfates. We had extensive testimony yesterday on that.

Again, it is a pleasure to have you here. I have really no questions, except we will need your assistance.

Do you believe that a case can be made for continued protection of national parks, in fact, increased protection of air quality and air pollution in our national parks, Senator Baucus?

Mr. BAUCUS. Absolutely. I can just tell you that around Glacier Park particularly. Flathead County borders Glacier Park on the west. The feeling in that part of the State of Montana is that there is not near enough attention paid to national parks, the Congress and the country must generally do still more to protect the pristine special nature of national parks because, as our society gets more complicated, it gets still more rushed, the comparative value of national parks in this country is becoming greater each year.

I just can't overemphasize the importance of protecting national parks in this country.

Mr. VENTO. I think it's necessary. Obviously, you agree that there ought to be an international agreement with regard to Mexican smelters. Are there any similar problems on the border with Canada? Of course, Glacier is on the border, is it not?

Mr. BAUCUS. Yes, Glacier is, the problem we have with Canada really affects a proposed coal mine across the border of Montana very close to Glacier Park. It is called Cabin Creek. We do have a treaty with Canada, the Transboundary Water Treaty, which governs transboundary pollution problems but only as it pertains to water. There is no treaty with Canada today that affects the transboundary air pollution. The problem is that this proposed project will lop off two hills and mine fairly high grade coal, ship it to Japan and other eastern Asian markets. The problem is that all of the water, the pollution flows south to Montana into a river that forms the borders of Glacier Park, also, all of the air pollution, because generally air currents flow south, too. So, all of the economic benefits would go to Canada; all of the environmental damage will flow south to the United States.

At the present time, there is no treaty that governs the two countries. There has been a reference, though, to the IJC, the International Joint Commission, on the transboundary water pollution problems. Hopefully, if the water problems can be resolved, that will tend to also resolve the air pollution problems.

Mr. VENTO. Well, of course, we are concerned about this Shamrock conference that occurred. We hope that more than appearances on the media will result in terms of it. But I think it does point out that it is a mixed bag. In order to get the Canadians to perform in terms of northern Minnesota and the proposed coal burning powerplant that was initially planned or in Montana, we have to be willing to address other problems that we have in the lower 48 as well.

Mr. BAUCUS. I would like to make two quick points, Mr. Chairman. First, I was disappointed that the President and Prime Minister Mulroney of Canada postponed a solution for 1 year. My judgment is that we have enough data. We have the information. Both countries should proceed. Although it might be a little presumptuous, I think the people of Canada, too, are a little upset that Prime Minister Mulroney postponed that for 1 year.

The second point is this. Acid rain is becoming much, much more of a national problem. It affects all parts of the country, not just the New England States. In the past couple of years, the Congress and the country has been divided on an approach to the problem because it has been perceived as primarily a midwestern source problem and a New England-Northeast result problem. It is now becoming more apparent it is a national problem.

I hope that you and your work in your committee will help form a national solution, because in our country we tend to get results only when a national crisis is perceived which tends to form national solutions. If we work together, recognizing this is a national problem, I think we will be able to work a little more forthrightly on it.

Mr. **Vento**. Thank you for that. I think it is also an economic problem. It is a question of who pays; we pay now or we pay later.

Mr. **Baucus**. That is the point I am trying to make. It is becoming more and more apparent that we all bear the cost of this, East and West both.

Mr. **Vento**. Let me call on the gentleman from Missouri, Mr. Emerson.

Mr. **Emerson**. No questions.

Mr. **Vento**. The gentleman from Pennsylvania.

Mr. **Kostmayer**. I have no questions except to say it is nice to see you back over here, Senator, over here where the real work is done.

Mr. **Baucus**. I can tell you, Congressman Kostmayer, after 6 years I am beginning to realize that more and more.

Mr. **Kostmayer**. Well, we miss you. We won't tell anybody over there you said that.

Mr. **Vento**. I always say that plagiarism is no stranger to any member of any legislative body, Senator. We would be happy to have you carry forth our good ideas in the Senate.

Mr. **Baucus**. Thank you.

Mr. **Vento**. We know you are able to do so.

The gentleman from California, Mr. Pashayan.

Mr. **Pashayan**. No questions.

Mr. **Vento**. The gentleman from California, Mr. Lehman.

Mr. **Lehman**. No questions.

Mr. **Vento**. Thank you very much, Senator. You have answered all of our questions. We will send you over a good product. Thank you very much.

The gentleman from California who chairs the Health and Environment Subcommittee of Energy and Commerce had hoped to be with us but has not been able to appear. I ask unanimous consent that we might place into the record Mr. Waxman's statement. Without objection, it is so ordered.

[**Editor's note**.—Prepared statement of Hon. Henry A. Waxman may be found in app. II. See table of contents for page number.]

Mr. **Vento**. We are grateful for his work. Obviously, he will be doing an integral role in terms of the issue of air pollution.

I am pleased to call on the Acting Director of the National Park Service, Ms. Mary Lou Grier. She will be accompanied by Dr. Richard Briceland, Phil Wondra, Bill Malm, and Molly Ross. I think you probably want those people at the table. Is that right, Ms. Grier?

Ms. **Grier**. Yes, Mr. Chairman.

Mr. VENTO. Welcome to the committee. We have a prepared statement. The entire statement will be made a part of the record. You can either summarize or read your statement.

[Prepared statement of Hon. Mary Lou Grier may be found in app. II.]

STATEMENT OF HON. MARY LOU GRIER, ACTING DIRECTOR, NATIONAL PARK SERVICE, U.S. DEPARTMENT OF THE INTERIOR, ACCOMPANIED BY DR. RICHARD BRICELAND, PHIL WONDRA, BILL MALM, MOLLY ROSS, JIM BENNETT, JOHN COOK, AND SUSAN SHERWOOD

Ms. GRIER. Good morning, Mr. Chairman.

We appreciate this opportunity to appear before your subcommittee this morning with an overview of the National Park Service's efforts to understand air pollution effects on the resources of the National Park System.

We know from our research efforts that air pollution can damage the resources that units of the National Park System have been created to protect. We recognize also that this is a national issue not confined only to parks, because parks have the same exposure to the effects of air pollution as the rest of the country and in fact the world. All branches of Government continue to wrestle with this question as a major national public policy issue.

We recognize that our obligation to protect park resources, including clean air, has been established by our Organic Act. In addition, the Clean Air Act charges the Secretary of the Interior, as Federal land manager, with an affirmative responsibility to protect from the adverse impacts of air pollution the 48 units of the National Park System designated class I under this act. In addition, the Secretary participates in the review of major new sources of air pollution proposed for location in areas where the air is cleaner than the National Ambient Air Quality Standards, in order to determine whether a proposed source will have an adverse impact on the resources of a class I park unit.

The Clean Air Act also requires the Environmental Protection Agency and the States to consult with the Secretary as a general rule concerning implementation measures affecting lands under the Secretary's jurisdiction, and in specific ways on issues such as redesignation of Federal lands and visibility protection of mandatory class I Federal areas. Through these and other provisions of the law, we attempt to fulfill one of the purposes of the Clean Air Act's Prevention of Significant Deterioration of Air Quality Program; in other words, to preserve, protect, and enhance the air quality of special areas including the units of the National Park System.

We take these congressionally mandated responsibilities very seriously. To carry them out, we have developed a number of programs that address air pollution concerns. We are extremely proud of our efforts to meet the requirements of the law.

Overall responsibility for our air quality program is in the Air Quality Office, an office created in 1977, with a fiscal year 1985 budget of $3.9 million, and with a professional staff of 18 people who have significant scientific, technical, and regulatory expertise. The responsibilities of this Office include assessing the conditions of park resources and air quality; identifying and assessing existing air pollution impacts and causes; integrating air resources management into Service operations and planning; developing interpretive materials for park use; participating with Federal, State and local agencies in the development of regulatory programs; remedying existing resource impacts; and preventing future impacts to units of the National Park System from manmade air pollution.

The Air Quality Office has been monitoring air quality and visibility in units of the National Park System since 1978. We have a monitoring program which includes quality assurance of data. It involves sulfur dioxide monitors at 11 parks, ozone monitors at 19 parks, total suspended particulate monitors at 16 parks, nitrogen dioxide monitors at two parks, a hydrogen sulfide monitor at one park, fine particulate monitors for visibility at 28 parks, teleradiometers for visibility at 29 parks, and cameras for visibility at 35 parks.

In 1982, the Office launched a major Biological Effects Program to study the effects of air pollution on vegetation. This includes air pollution effects surveys, sensitivity screenings, trace element surveys, and ecological surveys, with activities in fiscal year 1985 in approximately 35 parks. As with the scientific and technical activities in general, much of the biological effects research is performed by recognized scientific experts through contracts with universities, scientific laboratories, and other Federal agencies.

The Air Quality Office also runs two additional technical programs. Since 1979, the office has maintained expertise on pollution control technology for analyzing permit applications for proposed new facilities that have the potential to affect park areas. Also since 1979, the office has been engaged in applying and developing various models for tracing and predicting the movement and the concentration levels of air pollution.

In addition to the Air Quality Office, the Service has two other programs that address the effects of air pollution. As part of the 11-agency, 10-year National Acid Precipitation Assessment Program, the Service runs two long-term research efforts to study the effects of acid deposition on cultural and on aquatic resources. Funded in fiscal year 1985 at $725,000 and $511,000, respectively.

Our involvement in the cultural resource acid precipitation research program stems from our responsibility for the preservation of much of the cultural heritage of our country. Since 1982, the Service has begun 20 acid precipitation research projects of three general types, namely: inventorying and monitoring the cultural resources most vulnerable to air pollution damage; studying the deterioration process of sensitive cultural materials such as marble, limestone, mortar and bronze; and evaluating methods of mitigating the effects of air pollution.

Our research effort on the effects of acid precipitation on aquatic systems, also begun in 1982, now involves a wet deposition monitoring program in 27 areas, and watershed research projects in four national parks—Rocky Mountain, Sequoia/Kings Canyon, Olympic, and Isle Royale. The service is cooperating with others including the U.S. Geological Survey, to study parks in the Rocky Mountain region, the southern Appalachians, and the Sierras. The Great Lakes basin parks are being studied to determine how acid deposition correlates with water quality. Northwestern lakes and streams in Mount Rainier and North Cascades National Parks are being monitored for effects from acid precipitation.

We believe that our programs to address air pollution effects are excellent. We have assembled competent personnel, emphasized quality research with proper peer review, and established in-park monitoring programs to establish baseline data and to detect changes in air pollution levels over time. We have made substantial progress over the last 7 years. We recognize, however, that our research and monitoring efforts to date have been limited to selected park units, and our work continues as part of the national research effort on this question.

The results of our research and monitoring reveal serious air pollution problems in many units of the National Park System. We previously have provided the subcommittee staff detailed summaries of the effects of air pollution on vegetation, wildlife, visibility, cultural resources, and aquatic resources. We are submitting those summaries again today for the hearing record.

Mr. Vento. We appreciate that. I think that they are helpful to the hearings, very helpful. I want to state with special emphasis that members have before them the copies of those special impacts on parks, as well as Congressional Research Service, Library of Congress material. It's in that packet. It is quite voluminous, but be sure and look through your materials. I think that will be helpful in terms of giving you some guidance as to the effects on these 27 parks we are talking about.

Ms. Grier, please continue.

Ms. Grier. Mr. Chairman, I am going through my testimony basically trying to summarize, because it is long. It is a very complicated subject. I would like to have it entered into the record in full. But I have given you sort of an overview on our efforts to date.

We have assembled a team of ten superintendents, a number of our technical experts in this field, plus those at the table that you have already introduced, in order to answer your questions.

Mr. Vento. Thank you, Ms. Grier. I want to thank you at the onset for the cooperation that we have received. I realize it was no small undertaking to bring in the superintendents, but I felt it was necessary if we were going to make an assessment of the parks and the effects of air pollution in the parks.

I am concerned. I guess I could ask a lot of summary questions leading up to this question, but as an acting director, someone who has worked in this capacity now for a period of time and worked within the Department of the Interior, do you believe that the National Park System, the resources that we manage deserve continued and strong protection under the Clean Air Act?

Ms. Grier. Very definitely, Mr. Chairman.

Mr. Vento. Do you think that the recommendations which you would make on the basis of the studies would enhance or increase that protection?

Ms. Grier. I'm sorry?

Mr. Vento. Are there recommendations that you would make to enhance or increase the protection with respect to the air pollution problems that are being experienced in our parks?

Ms. GRIER. Well, I think you heard a number of recommendations yesterday from a good many scientists who do work for the National Park Service as well as other agencies. I think one of the things that struck me as I read that testimony last night was the general feeling that, frustrating though it might be, we are continually learning new things about this whole subject. I think the use of the word acid rain is a good example of that. As you pointed out earlier, we now find that there are impacts from other sources or other pollutants by other terms, ozone being an outstanding example, that have a good many adverse impacts on areas within the park system.

There is so much in the way of pollutants that is yet to be learned, I think.

Mr. VENTO. Ozone is a phenomenon that occurs as a result of a complex chemical reaction dealing with nitrous oxide, which a scientist had to help me through yesterday so I——

Ms. GRIER. It is very difficult.

Mr. VENTO. It is difficult, but I don't think, if we look at the effects and then look at what the cause is, and assume a cause-effect—now, of course, one of the problems is we are monitoring only in 27 parks. I would be satisfied with it, provided someone didn't say we had to go monitor in the other 307 before we could take any action. So, I don't criticize the limited amount of monitoring. We all have limited resources. Ideally, we would monitor in all 334 parks.

Of course, our monitoring programs, I think, are a problem to begin with. The fact that, as you are probably aware, we don't do dry deposition monitoring. Do you know why we don't do dry deposition monitoring, for instance, in the West? That would be very significant.

Ms. GRIER. I think that is a question that some of the scientists would have to answer for you, Mr. Chairman. I do know that is in the plans for Sequoia. They feel that need, according to articles I have read. I am sure Mr. Evison can respond to that in more detail as well.

Mr. VENTO. But you have no explanation for it?

Ms. GRIER. I think that's another step that we have yet to take.

Mr. VENTO. Well, money is probably one factor. Obviously, it is a costly factor.

Let me just get back to some of the specifics dealing with the Department of the Interior's responsibility, which I think are policy questions, are questions that an administrator should answer rather than a scientist, and/or assistants that are dealing with the administration of the law.

You describe the efforts to measure and monitor air pollutants in class I areas. Would you please describe your efforts to monitor—I think you have done that in the context of your statement. I think the question is how accurate that program is. Do you think it is an accurate program, the efforts to monitor in class I areas the degree of air pollution, Ms. Grier?

Ms. GRIER. I could just respond, and I will ask Dr. Briceland or Molly Ross to expand on my brief response. I am assured that we have a program of quality assurance on the data collected that gives credibility to that overall program. But I will be glad to——

Mr. **Vento**. I think to focus specifically on this in terms of quantitatively and qualitatively, and the number of stations—in other words, the quality of the data that is coming out of that, and the reliability of the instrumentation, and then, of course, trained manpower. Are there adequate amounts with regard to our national parks and class I areas?

Dr. Briceland, did you want to try that? Or is there someone else I should direct that to?

Mr. **Briceland**. Let me make a couple of comments on that, Mr. Chairman.

We are monitoring in 29 of the class I parks. I brought with me here—and I can enter it into the record, if you like—lists of some of the monitoring scientists and some of the universities, and some of the scientific organizations——

Mr. **Vento**. We have those. I would have the research scientists and principal investigators dealing with not just air quality but visibility and biological effect projects, and I would ask unanimous consent that the principal investigators and research scientists that are either on contract or actually professionals within the Park Service be made a part of our hearing record at the appropriate place. Without objection, it is so ordered.

[**Editor's note**.—The above-mentioned list may be found in app. II following Hon. Mary Lou Grier's prepared statement. See table of contents for page number.]

Mr. **Briceland**. Mr. Chairman, I just wanted to be sure that you had that for the record because I think that these are some of the preeminent people in the field. When we had discussions with staff last week and with you last week, the question of the credibility of the data did come up and we discussed that briefly with you. I think that the kinds of people and the kinds of institutions and organizations that we work with ensure the credibility of this data.

Mr. **Vento**. The reason, obviously, Dr. Briceland, that I am asking that question of Ms. Grier is because I want to make certain that that data is not challenged on that particular basis.

Let me get back to a class I area question and action. In class I areas where heavily traveled roads run through a valley or canyons surrounded by high mountains such as Yosemite, how do you measure the impact, for instance, of carbon monoxide concentrations and ambient air quality and on visibility?

Ms. **Grier**. You are asking a very technical question, Mr. Chairman. We can either answer it——

Mr. **Vento**. Well, do you measure carbon monoxide or carbon dioxide?

Ms. **Grier**. Not being a scientist, I would have to turn that over to the experts.

Mr. **Vento**. Doctor.

Mr. **Briceland**. Mr. Chairman, we have a number of the people here from the Air Quality Office who are specialists in each of these disciplines. That is a very specific question you have asked. I would prefer when we have that kind of question to have the individual who can give you the specific detailed answer come directly and provide it now rather than pick it up later.

Mr. **Vento**. I think that would be a good idea.

Mr. **Briceland**. Would you prefer to do it that way?

Mr. **Vento**. I think that would be a good idea.

Mr. **Bricelaand**. All right.

Mr. **Vento**. If someone would stand up who is qualified or has been assigned that particular responsibility and try and answer the question for the committee.

Mr. **Wondra**. Your question is regarding CO monitoring, visibility monitoring in Yosemite——

Mr. **Vento**. Valley areas, Yosemite or other similar areas, carbon monoxide monitoring.

Mr. **Wondra**. Carbon monoxide monitoring in Yosemite has been done when we have had episodes, and we have gotten cooperation from the California Air Resources Board——

Mr. **Vento**. Well, episodes has a specific meaning. I understand what you mean. Maybe you had better explain it fully.

Mr. **Wondra**. This situation was a fire in the back country that during the evening hours, night-time hours, would drain into the valley and leave the valley obscured in the daytime. One of the products of fire, in addition to the inhalable particulate, is carbon monoxide. We got very quick cooperation from the California Air Resources Board to perform that special monitoring, which indicated that we did not have a health problem at that time.

We have since purchased portable equipment so that we can address situations like that. Generally, the carbon monoxide problem in the National Park Service is one where you would have a queuing situation, where you would have automobiles waiting in line somewhere like an entrance station. We are concerned in the design and do model before these facilities are modified so that we——

Mr. **Vento**. Do you have a regular monitoring program, for instance, in Yosemite dealing with this particular problem or not?

Mr. **Wondra**. No.

Mr. **Vento**. Not a regular program.

Mr. **Wondra**. Not on carbon monoxide.

Mr. **Vento**. Did you have to actually close the park at one point because of carbon monoxide?

Mr. **Wondra**. No; we did not close the park. The levels were very low. There was no health problem.

We do monitor visibility on a regular basis. There is Dr. Bill Malm here, who can address how we monitor visibility there.

We also are installing three ozone monitoring sites there currently, in cooperation with the California Air Resources Board, again, in the park. This is to correlate our levels of ozone with damage that has been experienced in and around, or injury in and around, Yosemite.

Mr. **Vento**. Let me stop at this point and call on my colleague from Missouri, Mr. Emerson.

Mr. **Emerson**. No questions.

Mr. **Vento**. The gentleman has no questions.

The gentleman from Pennsylvania, Mr. Kostmayer. Do you have questions?

Mr. **Kostmayer**. Yes, I do.

Ms. Grier, the Air Quality Office, you said, for fiscal year 1985, the current year, the budget is $3.9 million with a staff of 18 people?

Ms. **Grier**. That is correct.

Mr. **Kostmayer**. Can you tell me what it is for fiscal year 1986 or what you are asking for?

Mr. **Briceland**. It will be essentially the same, Congressman.

Mr. **Kostmayer**. Can you give me the exact figure in the budget?

Mr. **Briceland**. Just a moment.

I believe the exact figure is $4,050,000.

Mr. **Kostmayer**. So, there is a slight increase?

Mr. **Briceland**. A slight increase, yes.

Mr. **Kostmayer**. Thank you.

I wanted to ask this: You mentioned, Ms. Grier, on the top of page 4, two studies, one costing $725,000 and the other, $511,000. Do you see where I am?

Ms. **Grier**. Yes, sir.

Mr. **Kostmayer**. Are those part of the Air Quality Office?

Ms. **Grier**. No, they are not, Mr. Kostmayer. Those are under the Cultural Resource Program Office.

Mr. **Kostmayer**. Is that the National Acid Precipitation Assessment Program study?

Ms. **Grier**. That is part of that; yes, sir. We head the interagency task force looking at effects on materials.

Mr. **Kostmayer**. Is that completed?

Ms. **Grier**. No, that is not completed. That is a long, ongoing effort. I guess it is about 2 years old, if I am not mistaken.

We have one example right here in the District of Columbia on top of the Post Office Building. There are a number of different types of materials, types of marble, bronze, all kinds of materials that are up on top of that roof and continually being tested.

Mr. **Kostmayer**. No evidence yet from that study that pollution comes from trees?

Ms. **Grier**. Not to my knowledge.

Mr. **Kostmayer**. Well, that's reassuring.

Thank you, Mr. Chairman.

I just wanted to check because I knew that was a real possibility.

Thank you, Mr. Chairman.

Mr. **Vento**. The gentleman from Utah, Mr. Hansen.

Mr. **Hansen**. Thank you, Mr. Chairman.

I appreciate your testimony. I wasn't sure of a couple of things that you brought out in your testimony. Did I understand correctly that the Park Service is assisting in the research on the acid rain problem but it doesn't have any specific control over clean air regulations? Do you folks have any control over clean air regulations?

Ms. **Grier**. No, sir. I think that is something handled by the Environmental Protection Agency.

Mr. **Hansen**. I see.

Ms. **Grier**. They have the responsibility for issuing——

Mr. **Hansen**. Yesterday during the testimony we heard from a gentleman here who brought in this research report. It is the "American West Acid Rain Test," an extremely interesting report. I am sure you have had access to it. Possibly you have looked it over in detail. I may use my own State as an example. It shows one place that there is monitoring in the State of Utah, on page 6.

Of course, we have a number of national parks. Do you monitor in any of the parks in Utah or, let's say, the Grand Canyon, for example?

Ms. **Grier**. Yes. We monitor in Bryce.

Now, these are acid deposition monitoring sites: Bryce——

Mr. **Hansen**. Zion, Arches, Canyonlands, any of those?

Ms. **Grier**. I guess Bryce is the only one in Utah. We do monitor in the Grand Canyon, yes, sir, as well, in Arizona.

Mr. **Hansen**. And what type of monitoring is this, dry monitoring?

Mr. **Briceland**. This is wet deposition monitoring.

Mr. **Hansen**. What have you found, may I ask?

Mr. **Briceland**. Yes, sir. I have supplied for the record a chart which I am holding up here which shows the range of the ph values that have been recorded at all of our monitorings, at 21 of our 27 monitoring sites that have been in effect for more than 2½ years. This bar graph indicates the range of values that has been observed each year and also gives an average for the pH levels that have been observed each year at these acid deposition monitoring sites.

Mr. **Hansen**. I think I will withhold further questions until we talk to the superintendents of those respective parks and possibly can go into a little more detail then, if that would be all right.

Thank you for your response. I appreciate it.

Mr. Chairman, I will yield back my time.

Mr. **Vento**. Fine.

The gentleman from California, Mr. Lehman.

Mr. **Lehman**. Thank you, Mr. Chairman.

I would like to follow up with the gentleman who answered the chairman's question. You mentioned ozone. What is the source of the ozone?

Mr. **Vento**. Can I have the gentleman's name for the record? I don't know which witness we have here.

Mr. **Wondra**. Phil Wondra.

Mr. **Vento**. Thank you, Mr. Wondra. Please proceed.

Mr. **Lehman**. What is the source of ozone pollution?

Mr. **Wondra**. The source at Yosemite or the source in general?

Mr. **Lehman**. Well, give me both.

Mr. **Wondra**. Let's see. There might be someone here who could better answer that question.

Mr. **Lehman**. Do we know the source?

Mr. **Wondra**. We know the emissions that react in the sunlight to cause ozone in the atmosphere, the precursor pollutants that create that. That is well known. The processes are very complicated, but we do know the sources. EPA has programs to address those emissions.

Mr. **Lehman**. If I wanted to know what was causing the ozone problem in Yosemite, could you tell me? Could anybody?

Mr. **Wondra**. We have not done any modeling studies for Yosemite, which are what is usually used to determine the source. We can monitor its presence, but to determine where it has come from, it takes dispersion modeling, where you actually model the atmosphere and determine how pollutants arrive at that monitoring site. We have not done that kind of work for Yosemite. It is very expensive. Right now our effort is to monitor what in fact is there in Yosemite.

Mr. **Lehman**. If we are to ever mitigate it, we would have to know the source. Is that not correct?

Mr. **Wondra**. That is correct.

Mr. **Lehman**. And the technology is available to ascertain that information?

Mr. **Wondra**. Yes, sir.

Mr. **Lehman**. OK.

Could any of you tell me what you're finding when you look at vegetation in our parks, where there have been what you think are effects from either—let's just take pollutants. What type of damage is being done, if any?

Mr. **Bricelend**. Mr. Congressman, again, we have submitted for the record a summary of the vegetation damage. Let me call Dr. Jim Bennett, who is here, who is head of our vegetation studies. If it pleases you, I would have him summarize for you basically what these vegetation effects are that have been documented in the material that we have given to you.

Mr. **Vento**. Mr. Bennett, can you find a chair there?

Mr. **Lehman**. Let me just ask you a question about the parks in my area. Let's take Sequoia National Park. You say over one-third of the Ponderosa pine studied since 1980 show moderate to severe ozone injury. What does that mean?

Dr. **Bennett**. The injury on Ponderosa pine appears as a form of yellowing of the foliage, of the needles, and a kind of burning of the tips of the foliage. The technical term for it is tip burn. We have some pictures of it over here on a posture which I can either show you now or this afternoon.

Mr. **Lehman**. Would you say that those trees are sick?

Dr. **Bennett**. Yes, I would.

Mr. **Lehman**. What would be the result of allowing that condition to continue?

Dr. **Bennett**. It weakens the tree. It slows down its growth. It predisposes the tree to greater infestation by pests and diseases. In general, it causes an earlier demise of the tree.

Mr. **Lehman**. Would you think that was a significant factor then, that in Sequoia Park there are moderate to severe injuries to over a third of the trees? Is that something we ought to be concerned about?

Dr. **Bennett**. Yes.

Mr. **Lehman**. How about in Yosemite? Do you have the same thing there?

Dr. **Bennett**. We are just starting this year to begin looking at it, because we have had anecdotal reports of the same kind of injury in Yosemite. We are going to begin looking at it this year—yes.

Mr. **Lehman**. You believe that is caused by air pollution?

Dr. **Bennett**. The symptoms that I described and which I could show you are diagnostic of ozone. They are only caused by ozone. When you see them on the foliage, you know that nothing else can cause those kinds of symptoms but ozone. There is nothing else that looks like it.

Mr. **Lehman**. OK. Are there any other factors causing damage to the vegetation besides ozone?

Dr. **Bennett**. In some parks, we have seen evidence of sulfur dioxide effects, fluoride effects, and heavy metals, which are also detailed on the list.

Mr. **Lehman**. And you think that, unless we reverse that problem, we are going to have some very sick forests? Tell me what the results are down the line.

Dr. **Bennett**. Well, are you familiar with the forests in San Bernardino County, San Bernardino National Forest——

Mr. **Lehman**. Yes.

Dr. **Bennett** [continuing]. In southern California, they have been exposed to the ozone a lot longer than they have in Sequoia National Park. What is happening there is a severe decline in Ponderosa pine. The forest, as a result, is changing its character. What is happening there could happen in Sequoia National Park if the conditions there continue—the air pollution conditions.

Mr. **Lehman**. Thank you.

I have another question. I understand from the studies that you are reporting injury and damage at pollutant levels that are below the national ambient air quality standards. Is that right?

Dr. **Bennett**. Yes; that is correct.

Mr. **Lehman**. Is that surprising, that you are finding it at those levels?

Dr. **Bennett**. Not really, because this is based on studies in the literature and our monitoring in the parks and has been known in the scientific world for some time.

Mr. **Lehman**. Has EPA been informed of that?

Dr. **Bennett**. Yes.

Mr. **Lehman**. So, they are aware of it.

Are the studies that you are doing being coordinated with other Federal agencies like the Forest Service and EPA then?

Dr. **Bennett**. Yes. In fact, we have six interagency agreements to conduct some of our work with various agencies, including EPA and the Forest Service as well.

Mr. **Lehman**. So, there is coordination going on that you think is sufficient?

Dr. **Bennett**. Yes.

Mr. **Lehman**. How long is it going to take before you think we have enough evidence to begin talking about some solutions?

Dr. **Bennett**. I am not qualified to answer that.

Mr. **Lehman**. How long are we going to study air pollution problems in our parks before we, you think, are competent enough in the field to say we know what's going on, we know why, and here's what we ought to do about it?

Mr. **Briceland**. Well, we are going to continue studying probably for quite a while, because the vegetative effects that Dr. Bennett has referred to have come principally from studies in just 10 of our parks. We have a lot of other parks that we need to begin looking at.

I think your basic question is what do we need to do about this, is the damage significant enough that we know what we need to do about it? Our role is really one of looking at our resources, trying to assess what kind of impacts there are being caused by air pollution, and the levels of pollutant, the concentrations of pollutants at which those impacts seem to be appearing. We, however, do not want to presuppose as to what kinds of actions should be taken either legislatively or administratively to respond to these. We think that really is an issue that the Congress has to deal with.

We will come forward to you and to the other committees and present the information we have about what we observe and what our research shows. But I think it would not be proper for us to suggest the remedies that should be taken to respond to this.

Mr. **Lehman**. Thank you, Mr. Chairman.

Mr. **Vento**. I appreciate that, Dr. Briceland, and the professional work that has been done both by private contractors working for the Department of the Interior as well as professionals. The fact is that there were statements made yesterday that there was no demonstration of damage in the Western United States from air pollution, from acid rain, from ozone, from heavy metals, and so forth. Of course, I think the work that has been done here solidly states that there has been damage, positive damage from ozone, positive damage from acid rain and from heavy metals, and so forth.

Certainly the visibility deterioration problems that we can all view, based on the evidence. I realize that Dr. Bennett is going to be back this afternoon to talk about the total vegetative effects. We are going to get back to that. First let me call on my colleague from North Carolina, Mr. Hendon.

Mr. **Hendon**. Thank you, Mr. Chairman.

I would only like to say how much I appreciate and how grateful we are for your interest in this, for holding these hearings, and for the work of our witnesses and many of those here today on this very frightening problem.

I would just like to welcome, Mr. Chairman, if I might, the former Superintendent of the Great Smoky Mountains, Boyd Evison. I haven't seen him in a while. Welcome back, Boyd. And say hello to John Cook, who is the Superintendent of the Great Smoky Mountains National Park. We think down our way, Mr. Chairman, one of the best in the whole system. Welcome.

Mr. **Vento**. Very good. There are a number of superintendents here today. We are again grateful that they are here. Obviously, the Smokies is one of the great concerns we have. I hope, Bill, that you will get a chance to look at those photographs that they have taken of that showing the visual pollution.

The gentleman from California, Mr. Lagomarsino. I am pleased to see his presence this morning.

Mr. **Lagomarsino**. Thank you, Mr. Chairman. I apologize for being late. I had to be elsewhere.

I want to welcome the witnesses, too. As I said yesterday, I think this is a very important set of hearings, both for finding out what is happening, what the prognosis for the future appears to be, and what we might do about it in correlation with others of our colleagues.

I would like to extend special thanks to the National Park Service personnel who have taken their time and effort to be here. I am certain they will be very helpful in our efforts to understand this problem.

In addition, I would like to commend the National Park Service for its outstanding work in this area. The Park Service has committed a significant amount of its funding and personnel to its Air Quality Monitoring Program since the establishment of that in 1978. I am sure that we will be provided with a lot of valuable data, as we already have.

In my own district in California, concern has been expressed regarding the effects of Outer Continental Shelf development on air quality, both onshore and offshore. This is particularly important in light of the fact that the Channel Islands National Park is located in the Santa Barbara Channel within proximity of the OCS development.

I am pleased that a joint interagency modeling study involving the Minerals Management Service, the Environmental Protection Agency, and the State of California has already been initiated to address the air quality issue. I have requested fiscal year 1986 funding for an important part of this study, the SCCCAMP project, which will provide some necessary air quality data so that everybody is starting from a common basis.

As the rate of OCS development escalates, we must begin to understand and, if needed, control any adverse effects of such activity. I would like to add, however, that my efforts to create the Channel Island National Park should not be interpreted in any way as a means to halt OCS development in this area. That had already started. We were well aware of that and of what the potentials were. On the other hand, it certainly doesn't lessen my concern for abating the problem and trying to control it as much as we possibly can.

I don't see any reason why such development can't go hand in hand with the preservation of what is already in the enhancement of our values.

Yesterday, I asked Senator Sasser about his comments on the Blankenship trout kill. He said I think that some 5,000 trout were killed there. He said that the dead fish were the result of acid rain, of acidity. I would like to explore this issue a little further, if I might.

Can you tell me what happened to fish in other parts of the park, any of the witnesses here?

Ms. **Grier.** Are you talking about the Great Smokies, Mr. Lagomarsino?

Mr. **Lagomarsino.** Yes.

Ms. **Grier.** John Cook.

Mr. **Cook.** John Cook, Superintendent, Great Smoky Mountains.

The fish kill Senator Sasser referred to took place outside of the Great Smokies. It is a trout farm operated by the Cherokee Tribe in North Carolina. However, Raven's Fork runs from within the Great Smoky Mountains. It is water that comes out of the park. TVA did do an evaluation of the cause of the fish kill. The determination was that pH, or acid pH factor, did cause the fish kill.

That is the extent of the information we have, or about all I can give you.

Mr. **Lagomarsino.** Have there been any fish kills in the park itself?

Mr. **Cook**. We don't have any trout farms or anything that would indicate such a large amount of fish kill. We do not have evidence that shows fish kills anything like the Blankenship one.

Mr. **Lagomarsino**. Thank you.

Mr. **Vento**. I suppose the inference is that, if it's unhealthy, the water coming out of there is unhealthy for fish out of the park, it isn't too good for the ones in the park either.

I guess the real problem here gets to be whether there is a continuing monitoring of aquatic species that is ongoing to determine an upturn or downturn in terms of those problems and what is the net effect of increased pH in the water. Obviously, trout happen to be a pH-sensitive type of species. You know, you can almost run the various types of species from trout down to rough fish in terms of pH.

Ironically, the most desirable species, walleyes in Minnesota, are under siege. That's my excuse for not catching any last week.

The gentleman from Ohio, Mr. Seiberling.

Mr. **Seiberling**. Thank you, Mr. Chairman.

These are extremely useful hearings, it seems to me, not just for the national parks but for the country as a whole. If there are threats to the national parks, obviously there are threats to all the other vegetation in the vicinity.

Ms. Grier, my understanding of the Clean Air Act is that, with respect to class I areas, which includes the 48 units of the National Park System that are designated class I in the Clean Air Act, that the standard the EPA is supposed to enforce is no significant impairment of air quality in those national parks. Is that your understanding?

Ms. **Grier**. I believe that is correct. I will refer to Molly Ross, who is our expert on that law, Mr. Seiberling.

Ms. **Ross**. Congressman, I think there are varying standards that are enforced cooperatively or in different degrees by EPA, the State, and the Federal land manager. In cases of the National Park Service, that is the Secretary of the Interior.

Mr. **Seiberling**. I am talking about the statutory standard. There is no significant impairment?

Ms. **Ross**. When you are dealing with new sources, major new sources near class I areas, the standard is that that new source shall not cause an adverse impact on the air quality-related values of the class I area. In visibility, the standard is significant impairment.

Mr. **Seiberling**. What about air quality, such as ozone, SO_2?

Ms. **Ross**. The general air quality standard, looking at what are the concentrations that are allowable generally, is the national ambient air quality standards that are supposed to be, under the Clean Air Act, protective of both the health and the welfare of the country. The welfare of the country includes basically all the resources that are embodied in the National Park System.

Mr. **Seiberling**. So, are you saying that no significant impairment only applies to the visibility?

Ms. **Ross**. That statutory term only applies to visibility. I think it is probably fair to say that term is very similar legally to the adverse impact term that is used with new sources and to the adverse effect term that is used with air quality generally in the national ambient air quality standards. All of those terms are supposed to protect against adverse or significant impacts.

Mr. SEIBERLING. Now EPA has responsibility for administering that. Is that correct?

Ms. ROSS. The primary responsibility for administering the Clean Air Act is in EPA and the States. There are designated roles for the Federal land manager, but they are limited and enumerated.

Mr. SEIBERLING. Ms. Grier, has the Park Service made any request to EPA for action in respect to air quality in the national parks that has not been responded to in accordance with the request?

Ms. ROSS. We had commented to EPA as one commenter in proceedings, for example, on the national ambient air quality standards, that to protect native vegetation, a lower standard may be needed. We asked for EPA's consideration of that. The final standard was not as low as the standard that we had asked for consideration of.

Mr. SEIBERLING. By low, you mean low in pollution?

Ms. ROSS. The concentration level, the national ambient air quality standards are allowable concentrations of pollution.

Our studies and review of the literature showed—and I think the results of our monitoring and research show—that effects on native vegetation are known to occur at levels below the current levels of the national ambient air quality standards. We have informed EPA of that formally in comments on the sulfur dioxide standard and our comments preliminarily on the particulate matter revision that is now underway, and also through our participation on ozone review panels. And, generally, it is well known in visibility that standards below the national standards can cause impacts on the very, very clean areas of our golden circle of parks, for example, in the West.

Mr. SEIBERLING. Well, if we are going to get a handle on this, we are going to have to get EPA in here, wouldn't you say?

Ms. ROSS. I think that EPA does play a major role in this.

Mr. SEIBERLING. Well, we hope they play a major role in it. Let's put it that way.

Well, thank you. That is very informative. Now I assume that the type of damage that has been shown in these photographs that you have brought has been brought to the attention of EPA. Is that correct?

Ms. ROSS. I think that's a fair statement.

Mr. SEIBERLING. All right.

With respect to your Air Quality Office, you have 18 people, professional people, with a budget of $3.9 million in fiscal year 1985. What has been requested for fiscal year 1986?

Ms. GRIER. Dr. Briceland just pointed out $4,050,000, I believe.

Mr. BRICELAND. Mr. Seiberling, the amount requested for fiscal year 1986 is the same as for fiscal year 1985. However, the rescission dollars that were originally in the fiscal year 1985 budget will be reinstated in fiscal year 1986. There is no increase requested. It is just to bring us back to the level before the rescissions took place.

Mr. SEIBERLING. What was that level?

Mr. **Briceland**. That level for fiscal year 1986 is $4,050,000, Mr. Chairman, as I recall.

Mr. **Seiberling**. How much was requested from OMB for fiscal year 1986? What was the original request of the Park Service for fiscal year 1986 for this office?

Mr. **Briceland**. Mr. Seiberling, as part of our budget preparation activities, we did include a number of candidate projects. I don't have the exact number of dollars for the increase, but typically they have run in the order of $200,000 to perhaps $1 million to deal with various kinds of activities that could represent increases in our program.

Mr. **Seiberling**. I see.

You said that you were only monitoring 10 parks; is that correct?

Mr. **Briceland**. No, sir. We are monitoring in 40 parks; 29 of them are class I areas; 11 are class II areas. My reference to the 10 parks was to the 10 areas where we had detailed vegetation effects studies.

Mr. **Seiberling**. Ideally, shouldn't those be extended to a larger number of parks?

Mr. **Briceland**. Yes, sir. We would hope that we could substantially expand both the monitoring activities for baseline data and the vegetation studies and the visibility studies.

Mr. **Seiberling**. Should all the class I parks be monitored?

Mr. **Briceland**. Yes, sir. We should have baseline data in all of the class I parks.

Mr. **Seiberling**. And if you didn't have it, it would be much more difficult for EPA to carry out its enforcement responsibility, I would assume. Would you agree?

Mr. **Briceland**. Well, we think that we are carrying out monitoring activities in all of the class I parks where we perceive that we have some potential violations or some potential problems. My comment about baseline data was that basically we believe that we need to have a baseline reference information for all of the class I parks and, frankly, for many of the class II parks. They are equally important parks and park units.

Mr. **Seiberling**. I would certainly think that you should. And if you did do that, how much more of a budget would you need?

Mr. **Briceland**. The monitoring work that we do for baseline data is such that after a few years we generally can say that we have good reference baseline information at a park, and therefore it may be possible to terminate or to suspend monitoring for a period of time and then come back into the park later.

Typically, our monitoring costs range—just a moment, Mr. Seiberling.

Mr. Seiberling, for criteria pollutant monitoring—this would be the sulfur dioxides, the oxides of nitrogen, ozone, and so forth—typically $30,000 to $35,000 for startup costs and perhaps $25,000 per year operating costs per site.

Mr. **Seiberling**. So, multiplying that with the number of sites that ought to be monitored, what would you come up with roughly?

Mr. **Briceland**. A lot of dollars, Mr. Seiberling.

Mr. **Seiberling**. Has any such information been conveyed to the Interior Appropriations Subcommittee?

Mr. **Brickland.** To my knowledge, they have not asked for exactly that information. We have in past years, however, indicated to them the level of funding that is required both to establish a monitoring site and to operate a monitoring site. But I do not believe that they have dealt specifically with what it would cost for various expansions of the program.

Mr. **Seiberling.** Mr. Chairman, I would hope that this subcommittee could bring to the attention of Mr. Yates' subcommittee this key information in connection with their deliberations on the 1986 fiscal budget.

Mr. **Vento.** I appreciate the gentleman's line of questioning and his effort. And I agree that there should be at least as much monitoring as necessary—I guess I am more action oriented—but I think the monitoring and the study for baseline data plus legislative changes have to occur.

Ms. Grier, the point, I think, that the gentleman from Ohio made was really a point that I think should be made: While you have no direct responsibility over the Clean Air Act, certainly as a Federal land manager, the Department of the Interior has a substantial responsibility. I think probably resources that are in the hundreds of billions of dollars that we are attempting and should be stewards to conserve and to protect. As a consequence, of course, this gets back to the exact issue that Ms. Ross brought out in terms of your communication with EPA in terms of setting particulate standards, sulfur emissions, nitrous oxide emissions, and so forth. I think that, if we know, even within the context of what has been established under the National Ambient Air Quality Act standards are insufficient because they still cause damage to these western parks and certainly to the eastern half of the United States; then we have to be concerned.

The other role or the other question that comes—and maybe this could be directed more to you—is what role does the Secretary of the Interior play with regard to individual projects on an individual basis within States? Is there an active role there that is being played by the Secretary in that vein?

Ms. **Grier.** Mr. Chairman, as I pointed out in my testimony, in fact it begins at the bottom of page 1, it lists the responsibilities that the Secretary of the Interior has as the land manager. And that, I might mention, with regard to the question from Mr. Hansen, your last point with regard to the responsibilities that the Secretary has under new proposals, proposals for new sources, major new sources of air pollution, would be, I guess you could interpret as a regulatory capability that the Secretary does have in issuing whether or not a permit shall be issued, whether or not the standards are set would be exceeded beyond which is acceptable.

So, we have the capability then of issuing or not issuing a permit for that particular new source. That you could——

Mr. **Vento.** How about specific actions, Ms. Grier? In your role as Acting Director, have you withheld any permits on the basis of air pollution problems?

Ms. **Grier.** I haven't. I don't know that that comes to me for that type of action. That would be——

Mr. **Vento.** Have you recommended that the Secretary do so?

Ms. Ross. The Secretary of the Interior has delegated his responsibility to the Assistant Secretary for Fish and Wildlife and Parks, who acts as a Federal land manager. We have been in this regulatory process since the amendments of 1977. Whenever there is a major new source near a class I area, we have to figure out whether there will be an adverse impact on our resources and so report to the State.

The Air Quality Office has typically staffed out the Assistant Secretary's office on that. To this point, we have not found an adverse impact on our resources.

I think it is fair to say that the key instances that we have been involved in where we have been working through the definition of adverse impact have been in North Dakota, with nine new sources where we certified no adverse impact from these new sources, and thereby allowed the State to issue the permit.

In Shenandoah National Park, we are, as you have already heard and seen, concerned about ozone pollution there. We had two major sources of the precursor pollutants to ozone that came before us just last fall. We had a difficult decision in advising the State what we know about pollution there in a situation involving ozone where EPA has not yet established a class I increment or equivalent measure. We decided that we could not yet call that adverse impact, but we expressed to the State our very serious concern about what we are seeing in Virginia. At that point, it was up to the State to decide what to do on those permits.

Mr. Vento. It is safe to say, I guess, that you place a very hard test on adverse impact. Is that right? In other words, you cannot find adverse impact within the ambient air quality standards? Is that the point or not?

Ms. Ross. I think the national ambient air quality standards, as envisioned by the Clean Air Act, were meant to be the national standards protective of health and welfare. The PSD, or prevention of significant deterioration section of the Clean Air Act, was an additional section meant to look at what the effects are on the clean air areas of the country, including class I parks, and to recognize that effects may occur at levels below national ambient air quality standards and to provide some tools to address those effects.

We have been working through a definition of what we consider an adverse impact. I can say quite honestly that it is quite a cosmic question. I think we have made a very good attempt at putting forward some criteria in defining what we think an adverse impact is. And these criteria have worked well, we think, in the situations in which they have been applied.

We have announced in the Federal Register twice that we intend to go forward with a rulemaking to try to better flesh out what this definition should be through a notice and comment proceeding in addition to the notice and comment proceedings we have already had.

Mr. Vento. The fact is that, as information continues from the national parks, some of those decisions in terms of legal tests that you are placing on adverse impact might very well change because they will be buttressed by additional information. Even the most recent report to this committee indicates substantial damage.

It seems to me a difficult task to run around to each State that might be in a permitting process for a point source of either nitrous or, more likely, sulfur dioxide. Isn't that kind of a problem, running around to all of the States that might be impacting? How are you made aware of these permitting processes? Is this mandated by the States to weigh in with the Department of the Interior or what, Ms. Ross?

Ms. ROSS. The Clean Air Act says that the Federal land manager shall be notified of any major new source that has the potential to affect a class I area. EPA has a working policy that it has communicated to the States that, whenever there is a major new source that will be located within 100 kilometers of a class I area, or a very large major source beyond that distance, the Federal land manager shall be notified. When that process works well, we get into the permit review process as early as we possibly can, so that we can sit down with the permit applicant.

Mr. VENTO. How many cases would you get into in Alaska?

Ms. ROSS. We have had very few sources to review in Alaska thus far.

Mr. VENTO. Well, is Alaska excluded? The parks are excluded from class I areas.

Ms. ROSS. At present, there is only one park class I area and maybe three fish and wildlife—we also do the fish and wildlife for class I areas——

Mr. VENTO. I think it's an interesting example. Here we are talking about where we have designated and classified hundreds of millions of acres of public parks, and so forth, and so on, and you maybe cover 5 percent of it. In other words, that's the only permitting process you are involved in. So, the other 95 percent of it is not covered. Would that be an accurate statement?

Ms. ROSS. Not covered in the new source review process.

Mr. VENTO. That's right. So, you don't even review those other 95 percent. What percentage of the parks in the lower 48 are class I areas, Ms. Grier?

Ms. GRIER. It is 48 out of 334 units. However, units——

Mr. VENTO. About 300 don't receive any review. So, 90 percent in the lower 48 receive no review. Is that right?

Ms. GRIER. Well——

Mr. VENTO. Unless you take it upon yourself, in other words, you are not notified. Have you taken independent actions other than when you have been notified, to review an adverse—and, of course, the class II parks, because of the air quality and their intimacy—like you take Cuyahoga, which is between Akron and Cleveland, would be an area that is a problem area, right?

Ms. GRIER. There's monitoring——

Mr. VENTO. Ms. Ross, do you have a comment?

Ms. GRIER. There is work going on at Cuyahoga.

Ms. ROSS. Mr. Chairman, we do review permits in class II areas to the extent that we know about them. The difference is, we don't have a regulatory notification process as we do in class I areas.

Mr. VENTO. Do you think that that would be useful? Would that be helpful if you are going to participate, to be aware of what is going on?

Mr. BRICELAND. Yes, sir.

Ms. **Ross**. I think so.

Mr. **Vento**. So, I think that that would be one place that we probably could agree. We might increase the workload on the Department of the Interior in this area, but if it's your job to conserve and to be a good steward, then you ought to know what's happening in Akron and Cleveland and Minneapolis and St. Paul and other places. Right?

Ms. **Grier**. That's correct.

Mr. **Vento**. I don't want to pick on Cleveland and Akron, Mr. Chairman.

Mr. **Seiberling**. Let me say, since it has been mentioned, that the air quality in the Cuyahoga Valley, I would suspect, has improved considerably in the 11 years since that park legislation was adopted, partly because of enforcement of auto emission standards and industrial standards, and partly, I am sorry to say, because of the deindustrialization of northeastern Ohio that has been going on.

Mr. **Vento**. Everybody is coming to the subcommittee pointing out to us the absolute reduction of sulfur dioxide emissions, and so forth. The only problem is, of course, that the damage is cumulative. In other words, a lot of soils and a lot of it, once it is submitted, it's a sum total game. You either fill up your absorption capacity in the southeastern part or put it directly into streams and bodies of water like the Great Lakes, we don't get rid of it.

Mr. **Seiberling**. Well, of course, another aspect is that we are getting pollutants from a lot of other areas, not just local areas. We are getting it from States to the west and south and even from Canada.

Mr. **Vento**. And proposed pollution from Mexico.

These are, of course, reasons why we need to look at this on a regional basis and on an international basis, not solely within parks or only within States, which is the case.

I just wanted to point out that there are a few loopholes in the nature of the way that we are approaching the problem here. I am pleased to hear that you do receive notification. But I think we probably could agree on some things in terms of notification: What you should do, how aggressive you should be. I guess I would want you to be real tigers with regard to this. I think that is based on the amount of resource you have committed and based on facts. Once we have the facts, it has always been my hope in terms of public policy, that the Congress, the administrators, and industry would make the right decisions with regard to these issues.

I think that we can marshal the facts by buttressing what is being done with the acid rain deposition national program and the interagency task force, it's good. But, you know, that doesn't always work out that way. Here I've got an article before me that a work group suggested new fine particle standards, but the acting air chief, Elkins, opposes and staff opposes the visibility control.

Mr. Wondra, you mentioned you would like to talk about visibility and controls. According to this article, proposals by the internal EPA task force on visibility are being opposed by Charles Elkins, the acting chief for air and radiation programs on the basis of insufficient data. The task force recommendations included increasing research in key areas, including visibility impacts.

I don't know how you can be against increasing research if you think you need more information. But apparently Mr. Elkins is. But I expect that including visibility impacts in other Clean Air Act policy considerations such as new source performance standards, mobile source control programs, smelter control requirements, and developing a fine particulate standard. What is the National Park Service response to the EPA task force proposals? Have you communicated the same to Mr. Elkins with regard to this controversy between apparently Mr. Elkins and his staff? I invite you into this problem. Mr. Wondra?

Mr. WONDRA. Mr. Chairman, I am going to turn this over to Dr. Bill Malm.

Mr. VENTO. OK.

Mr. MALM. We concur with many of the recommendations. I think one point that should be made——

Mr. VENTO. You concur with his staff recommendations to him? Is that correct?

Mr. MALM. Yes. Many of the recommendations include the adequacy of our monitoring program. We talk about a monitoring program and the fact that we monitor in 30 areas, and so forth. But I think one thing that hasn't been pointed out is that, even though we have a monitoring program and we monitor some things very well, there are some things that we don't monitor for at all. For instance, in the National Park Fine Particulate Monitoring Program, we don't monitor for nitrates. Nitrates are brought up as an important pollutant. We don't even monitor for them.

Mr. VENTO. In which park is that?

Mr. MALM. In any of the parks.

Mr. VENTO. In any of the parks and, yet, in the West, according to the World Resources Institute study, this is the key problem in the West. I don't know if you agree with that or not, but at least that is their point.

Mr. MALM. Let me respond to that in a second.

Mr. VENTO. OK.

Mr. MALM. Second, we don't monitor for carbonaceous material, elemental carbon, which is the kind of soot that comes out of automobiles, diesels, or the organic aerosols, the organic material that is formed from hydrocarbon emissions and nitrogen oxide emissions.

Mr. VENTO. What my question was to Mr. Wondra before about regular monitoring for carbon monoxide in Yosemite.

Mr. MALM. Well, carbon dioxide is a gas. I am referring to the secondary particles that are formed from some of the gases that are put into the atmosphere.

I guess the point I would like to make is that, even though we monitor some things and we do a very good job, I think monitoring those things that we have instruments out there for, there are a number of things that we do not monitor for in any of the national parks. That is one point.

The second point with reference to the relative importance of nitrates and sulfates, nitrates tend to be an important particulate or pollutant when the national park is located in proximity to the source. As you move away from the source areas, the problem converts itself into a sulfate problem. So, if the park is 200, 300, 400 kilometers away from the source area, you tend to find very low concentrations of nitrates. If you move in close to the source area, around a powerplant, around an urban area, then the nitrates are a more important issue. Of course, there are many national parks both that are quite distant from sources as well as right next to them.

Mr. **Vento**. And you wanted to comment on the other issue? Of course, the point is, just picking up that nitrate issue, is the ozone factor that is formed from those nitrites also just a localized problem then or of more concern?

Mr. **Malm**. No, ozone is a gas. Since it's a gas, it is transported over hundred of kilometers. For instance, even though ozone may be produced around the urban area of southern California, it can be transported hundreds and hundreds of kilometers into the Grand Canyon and all the way up into Rocky Mountain National Park.

Mr. **Vento**. Of course, the positive damage, the vegetative damage that was referred to by the expert on that topic that we are going to hear from later this afternoon, Mr. James Bennett, you know, constitutes a very serious problem, one-third of the trees in one of the parks.

I guess that the point is, getting back to the Elkins matter, that you have, in other words, communicated with the EPA on this matter. Has the National Park Director, the Secretary of the Interior, communicated with Mr. Elkins concerning this report on visibility or not, Ms. Grier?

Ms. **Grier**. It is my understanding, Mr. Chairman, that our comments on the record at EPA made the same recommendations as staff recommended.

Mr. **Vento**. Well, I hope that we make a little noise about it, have a little administration infighting, it might be appropriate. I really think, in terms of the role that the secretary plays here, and I commend him for taking that action. But I think that, when we get down the line, you know, that we obviously, all of us, want more information. I think that we have to act on the basis of what we know at this point.

Let me just refer a few questions—of course, we will leave the questions for the record open.

On visibility, I am well aware the National Weather Service has the oldest records on visibility. Do you have monitoring programs now that are ongoing on the visibility issue? I know that we had some of the contract and private scientists in yesterday that are working for you on that issue. I am interested in what your plans are for that and the nature of that particular program, Ms. Grier.

How long have they been going on?

Ms. **Grier**. I believe since 1978.

Mr. **Malm**. I can refer to that. The National Park Service became involved in visibility monitoring in 1978 in seven national parks. Shortly thereafter, seven more parks were added to the monitoring program, a very minimal effort at that point. So, in 1978 and early 1979, we had monitoring of about 14 areas.

Mr. **Vento**. Are you able to correlate the monitoring that you are doing now with that which other agencies; namely, the National Weather Service, had done in regards to visibility monitoring to determine what the progression or problems, or changes are?

Mr. **Malm.** Yes. The data is fairly well correlated. There is a correction factor, as you always have with databases that are done in different ways and extend over different periods of time.

The data derived by the National Park Service and carried on by the other agencies and other contractors that testified yesterday are basically all done the same way. They all are highly correlated with the National Weather Service data that extends back to 1948 in some cases.

Mr. **Vento.** Your conclusion in general is what, concerning the changes in terms of visibility associated with our national parks?

Mr. **Malm.** It depends upon whether you are talking about the eastern situation or the western situation. They are two uniquely different situations there. In the East the visibility, as John Trijonis testified yesterday, is decreased from, say, on the average of 60 miles in the East down to less than—our monitoring data today show that typical summertime visibilities are less than 25 kilometers, as low as 10 kilometers in some cases.

In the West, the typical visibilities are about 150 to 200 kilometers. There are few instances, specifically in California, where there is a long-term record. Where that record has been analyzed, the visibility within urban areas has actually increased because of the air quality standards, because of the control of the emission from cars and certain stationary sources. However, in the more pristine areas of California there has been a continual degradation of visibility, as reported by the California Air Resources Board. They suggest that that reflects the additional population growth outside the major urban areas itself.

So, the record is varied as you move around the country.

Mr. **Vento.** But in general the trend is downward, in these pristine areas it is downward? In the East and some urban areas in the West which do not have a long history apparently, the West does not have a long history in general of monitoring? In other words, the National Weather Service monitoring apparently didn't occur there as much as it did in other areas, but that the trend is down. Part of it is urbanization and other factors, I guess, that contribute to it. But the fact is the visibility and these vistas have been impaired.

Degradated was the word that you used.

Mr. **Malm.** The general trend—where the data has been analyzed, the trend has been down in the pristine areas. In some cases it has become better in the urban areas.

Mr. **Vento.** Well, that's good for those of us that are walking or jogging around urban areas. It's not so good for the areas we look at as being the crown jewels of our system.

I think you have been generous with your time.

Does anyone else have any further questions of this panel? I know that Dr. Briceland will be around. We probably will be calling him back and maybe some of the others. But I do appreciate again your cooperation and the presence of the park superintendents as well as your testimony today, Ms. Grier.

Mr. **Seiberling.** Mr. Chairman, I have a couple of questions.

Mr. **Vento**. The gentleman from Ohio has questions of the witnesses.

Mr. **Seiberling**. I read with great interest the statement of Ms. Grier about the work being done on damage to cultural properties. I just wonder, have you reached the point where you developed some methods for preventing further deterioration of some of these parks of our Nation's heritage?

Ms. **Grier**. I think probably staff will go into this a little further, Mr. Chairman. It is my understanding that, as of now, we really can't say with any accuracy how to prevent it at this point, mainly because this has been a program that has been ongoing for only a 2-year period. We are part of an overall interagency effort, as in all other areas of this problem; in fact, we head up an interagency task force in the government dealing with that subject.

Mr. **Seiberling**. This is a problem that is not limited to the United States alone.

Ms. **Grier**. That is correct.

Mr. **Seiberling**. In Paris they have had problems with, for example, the deterioration of Notre Dame Cathedral. I believe that they have actually replaced some of the sculptures there. But I understand they have also developed a technique for coating the limestone with plastic film sprayed on, I guess, and various other techniques to protect these monuments. Have we looked into what other countries are doing along these lines?

Ms. **Grier**. Mr. Chairman, while we are on the subject, now I would like to call on Susan Sherwood, who is heading up that program in our Washington office, and has that responsibility.

Mr. **Seiberling**. I guess in Athens the Parthenon has been deteriorating rather rapidly in recent years because of air pollution.

Ms. **Grier**. I think one of the things we have learned, Mr. Seiberling—I think Europe learned and we are learning now—is that there are certain materials that it is better not to use. We find that out as a result of——

Mr. **Seiberling**. Unfortunately, our forebears didn't foresee this problem.

Ms. **Grier**. That is correct.

Mr. **Seiberling**. We have to try to protect what they have left to us.

Ms. **Grier**. As early as the Parthenon, too.

Mr. **Seiberling**. Yes.

Ms. **Sherwood**. Congressman Seiberling, to answer your question about methods to——

Mr. **Seiberling**. What is your name?

Ms. **Sherwood**. Susan Sherwood.

Mr. **Seiberling**. Thank you.

Ms. **Sherwood**. To answer your questions about prevention or protection methods, in the instances of metals, bronze statues, for example, there are appropriate and reasonable methods that can be undertaken to extend the life of bronze statues. There is a cost associated with that, but that is something that is technologically possible.

On the issue of stone, limestone and marble deterioration, that is a much more complicated issue. To date, none of the treatment systems that have been proposed and has been tried has been proven to be effective over the long term. In some cases, the treatment systems tend to do more damage to the stone than was already done by the weather itself.

Mr. SEIBERLING. I noticed the last time I was in Europe, or at least the last time that I was in Paris, that all during the sixties, and I was over there several times, the French Government had undertaken a program of cleaning many of the old buildings, I guess on the theory that the coating of soot and so forth was bad for the stone. So, they all looked beautifully pristine. Now, what has happened? Has any study been made as to whether that helped or damaged these buildings?

Ms. SHERWOOD. The French, as part of an international effort, are leading a documentation program for treatment of cultural properties. So, when an action is taken on a building such as the cleaning of Notre Dame or the consolidation of the stone at the Acropolis, that will be fully documented and then monitored over time in 5, 10, 20-year periods. But when we are talking about monuments like the Parthenon, the Statue of Liberty, Notre Dame, we are talking about very, very long time periods. So, 10 years is very short in the life of Notre Dame and is something that may be equivalent to 1 year in our lives.

These things need to be watched over a long period of time. So, something that might work for 5 or 10 years and make the building look clean and sharp may, 20 or 30 years down the road, have built in some problems in its long-term maintenance.

Mr. SEIBERLING. But isn't it true that the deterioration in the last, say, 25 years is probably equal to something that might have taken centuries before we had so many pollutants?

Ms. SHERWOOD. That's quite possible. One of the purposes of the research program that is underway now is to isolate out those effects of pollutants versus natural weathering. We have just begun that process. So, we hope to have that answer for you.

Mr. SEIBERLING. But certainly reducing the pollutants is one part of the solution, I presume.

Ms. SHERWOOD. It certainly couldn't hurt the cultural property.

Mr. SEIBERLING. Thank you. I personally preferred looking at those ancient buildings when they were all covered with soot. I thought they looked much more dramatic, but anyway that's personal taste.

Now, Ms. Grier, I gather that, as far as the parks are concerned, there is no feeling that we have a problem in Alaska with respect to air quality at the present time, is there? Is there any basis for that feeling?

Ms. GRIER. I haven't heard of anything being raised with regard to Alaska parks.

One thing I did hear on the news, which I thought was most interesting, about 2 weeks ago, was that they were finding a great deal of visibility problems in an area of Alaska. The consensus then was that it was coming from either the Soviet Union or either East or West Germany, which I thought was interesting. I think it points up what the chairman said earlier. The international effect that this creates goes far beyond a park boundary or regional boundary or even this country.

Mr. SEIBERLING. Shouldn't we start to establish some baselines for Alaska parks before the problem gets really serious? This would be a good time to do that, I would think.

Mr. MALM. Yes, sir. I think we probably all concur on this point, although at this point we aren't monitoring particulates or visibility. I don't know about the criteria pollutants. Within the current budget, there aren't adequate dollars to initiate that monitoring.

Mr. SEIBERLING. But if we had the resources, that would be a good thing to do, wouldn't it?

Mr. MALM. It's one of the pristine areas. It is possibly one of the more pristine areas we have in the National Park System. And, yes, we ought to establish a baseline. At this point we do not know whether there are elevated levels of pollution there or not.

Mr. SEIBERLING. Thank you very much.

Mr. Chairman, I am very impressed with the professional staff testimony of this hearing. I am not denigrating anybody else's testimony. I just think that we don't usually get this many professionals here. They have done an outstanding job. I think it is a good time to recognize them, just taking this opportunity.

I want to thank Ms. Grier, too, for her testimony, which I think is very helpful indeed.

Mr. VENTO. I think you are right. Obviously, the staff deserves it. I think it is necessary in this, obviously, as we struggle, all of us, to understand and deal with these complex problems. I do appreciate the work they are doing. I think that it is a major area. We want to communicate with the Appropriations Subcommittee in terms of trying to get the adequate information.

I apologize for not recognizing the gentleman on a second round of questioning as I initiated it, the gentleman from California. I would love to stay and ask additional questions, but the nature of the panels that we have following, we want to do justice to them. So, we are not out of questions, but we are going to run out of time.

Ms. Grier?

Ms. GRIER. I would just like to thank the chairman and Mr. Seiberling for those kind words about the staff. As I pointed out to you, we are proud of the work that the Park Service is doing. We think that we have an outstanding staff. We rely on the staff. Needless to say, we are not experts in that field. Those of us who have to try to make decisions have to rely upon this type of expertise and background. So, we thank you for those words.

Mr. VENTO. You're welcome. Thank you, thank all of you.

We have the first of a number of panels of park superintendents, who we are very pleased to have here today. The first two that I would like to call to the table are Mr. Boyd Evison, who is the Sequoia/Kings Canyon National Park Superintendent from California, and Mr. Robert Chandler from Olympia National Park in Washington.

As they are taking their seats, I have a request for unanimous consent to insert a statement by the gentleman from California, Mr. Coelho. It concerns the San Joaquin Valley of California. Without objection, that statement is made part of our record.

[EDITOR'S NOTE.—Prepared statement of Hon. Tony Coelho may be found in app. II. See table of contents for page number.]

Mr. **Vento**. The agreement with the superintendents is that they would not submit specific testimony but, we would hope, would respond to our concerns about what is specifically occurring in their park.

Gentlemen, it is a pleasure to welcome you. I haven't had the pleasure to, I believe, meet either of you personally. So, I have to assume that Mr. Chandler is there, and Mr. Evison is the other.

PANEL CONSISTING OF BOYD EVISON, SUPERINTENDENT, SEQUOIA AND KINGS CANYON NATIONAL PARK, AND ROBERT S. CHANDLER, SUPERINTENDENT, OLYMPIC NATIONAL PARK

Mr. **Vento**. Mr. Chandler and Mr. Evison, Mr. Pashayan, I think, will be by, if he is not already here. I am sure that he will have a formal welcome for you.

Mr. Chandler, is there any air quality monitoring currently going on in Olympic?

Mr. **Chandler**. Yes, sir, Mr. Chairman. There really are four different types of air quality monitoring at Olympic National Park. We are doing visibility monitoring, which consists of taking photographs at three fixed points in the park every day to record changes in visibility from those stations.

We have also been part of the NAPD acid rain network since 1981. In 1984 we are now part of the NAPA Program. The latter two monitoring sites are on the western slopes of Olympic National Park, which is believed to have some of the cleanest air in the monitoring system.

There is also a monitoring control station that is really managed by the Olympic Air Pollution Control Authority, which is a State-sponsored program which is within the boundaries of the park.

Mr. **Vento**. It does not relate directly to the interagency work, it is obviously funded solely by the State, but is that information of the same integrity as the other work that is being done?

Mr. **Chandler**. Yes. It is also measured for quality assurance. The data is furnished to the park and submitted through us to the researchers that are looking at the total data that is collected within the park.

Mr. **Vento**. Mr. Evison, is there similar work going on in Sequoia?

Mr. **Evison**. Yes, sir, there is. We have an NAPD station measuring wet precipitation in the Giant Forest, one of the areas with which we have considerable concern in the parks, two additional samplers run by the California Air Resources Board at low and high elevation sites in the park dealing with acid precipitation. We have work being done on ozone monitoring at various points in the park. We have kind of on our own hook some photographic work being done from Giant Forest, done in a way that the EPA would conduct it, we understand.

We have monitored SO_2 in the past at the lower elevation site and had indication that there was no severe problem in that area. We have had high volume particulate samplers at low- and midelevation sites in the park, part of the California Air Resources Board network. We have had some preliminary studies on dry deposition, which seems to be the thing that is hardest to deal with and on which there is some disagreement among scientists about how best to handle it.

Mr. **Vento**. Is the work in your park being done by park personnel or are these on contract? Obviously, Mr. Chandler explained that even the State is doing some work in Olympic.

Mr. **Evison**. The great majority of the work being done is being done by people outside of the National Park Service. The biggest part of the funding actually comes from the California Air Resources Board.

What we have used as seed money from the NAPA Program, starting in 1982, I believe, and we have used that in a very good and small science staff in the park to encourage others to come in and do research which will be useful to us and, we are sure, to them.

Mr. **Vento**. Has that worked out pretty well? Have there been any takers on it?

Mr. **Evison**. Yes. We have had phenomenal success.

Mr. **Vento**. You are very encouraging. I wasn't aware of the State participation in Washington and in California. I might say my own State of Minnesota has had an interest in that matter as well, although I couldn't really tell you to what extent. But it sounds as though the integrity of the information that will be forthcoming will be very helpful.

You alluded, Mr. Evison, to the results of that. What have they been? In your description, has there been any damage identified or threats to vegetative systems, to plant life in Sequoia?

Mr. **Evison**. Yes. There has been documentation of damage to yellow pines and black oaks in the parks attributed to ozone. We are early enough in the process of working on acid precipitation problems so that we can't really tell you what is happening as a result of that in the parks. We do know something about the pH levels of what is coming in and how they compare with what is thought to be normal pH.

Mr. **Vento**. So, both ozone and pH level damage has been noted, is what you are suggesting?

Mr. **Evison**. Well, no, not damage. We can't say for sure that there is damage attributable to lower pH.

Mr. **Vento**. Well, let's use the word air pollution, air pollution damage.

Mr. **Evison**. I believe that the only kind of air pollution that we can safely say is directly a cause of damage to resources in the park is ozone.

Mr. **Vento**. Is ozone. That's very unique.

Mr. Chandler, how are you going to answer that question?

Mr. **Chandler**. We have no indication at this time of any damage within the park. One of the interesting things——

Mr. **Vento**. We are talking about plant damage now.

Mr. **Chandler**. Plant damage.

Mr. **Vento**. We are not talking about soils or anything else.

Mr. **Chandler**. That is correct. There has been no indication of plant damage that we are aware of at Olympic.

Part of our interest there is that Olympic is a relatively clean site and, as soon as possible, get a baseline established against which we can begin to identify effects early on rather than waiting until we can visually see that we have a problem and then try to find out why.

Mr. **Vento**. With regard to the ozone problem in Sequoia, have you been able to determine any trend with regard to that damage, Mr. Evison?

Mr. **Evison**. I don't think so really. Unfortunately, we are not in as good a situation as, for example, Olympic and probably the Alaskan areas are, in that we got into the beginnings of establishing baseline data well after the problem had been a pretty serious one for some time, we think.

But we will be able to tell over time whether or not there are trends in either direction, I would think.

Mr. **Vento**. One of the things that we get into, I guess—and I first raised this question with a number of others this morning—and that is, how do you mitigate the effects of this ozone, if it's nitrous oxide? Are you close to an urban area or not?

Mr. **Evison**. I am sorry?

Mr. **Vento**. How far are you from the urban area?

One of the things that distinguishes our problem from that of most of the other forests is that most of it seems to be home grown. An awful lot of it comes from the San Joaquin Valley and as far north as the bay area, quite a bit of it from Fresno. What are the distances there? Mr. Lehman will assist me in providing background information.

Mr. **Lehman**. Fresno is about 1 hour's drive from the entrance to Kings Canyon/Sequoia. Visalia is about an hour's drive also. But I think the key factor is the San Joaquin Valley, which potentially is the worst air basin in the United States. It is not so yet, but the problem is that there is no means for the pollution to get out of the valley. At least in Los Angeles they can have a wind that blows it off to the desert or takes it someplace else. But the San Joaquin Valley is an enclosed area, and the pollution that gets there from the bay area or is generated there usually stays there. So, it is building up and it's getting much worse.

Many days in Fresno, most days out of the year, I know the superintendent will agree with me, you can't see the mountains. And that didn't used to be the case.

Mr. **Seiberling**. Would you say that the people should not smoke cigars in the San Joaquin Valley?

Mr. **Vento**. Mr. Pashayan, given the gentleman from California——

Mr. **Pashayan**. Given the origin of cigars; namely, it is a plant, I should think that other plants ought to find its smoke acceptable and receptive.

Mr. **Seiberling**. They shouldn't smoke cigars anyplace.

Mr. **Pashayan**. But remember, I do not pollute my cigars by driving the smoke through filters. It comes out naturally.

Mr. **Vento**. Please denote the gentleman from California, Mr. Pashayan, is present.

We are asking some questions concerning the matter with regard to vegetative damage. I guess we can also get into aquatic and into visibility. Of course, the gentleman from California, Mr. Lehman, recognized that particular problem.

Have you any visual monitoring activities going on in the parks this time?

Mr. **Evison**. Only that that we have initiated on our own. At one point we have a camera that takes photographs at regular intervals, essentially in the same way that EPA is set up to do the same things, as I understand it. That has been going on for—I think we are in our third year of doing that now.

Mr. **Vento**. The case with Olympic, Mr. Chandler?

Mr. **Chandler**. Yes, the same thing. As I stated earlier, we have three stations within the park. We take photographs daily at those stations and maintain a record of the changes in visibility. In general, the only visibility problems that we have identified at Olympic results from slash burning adjacent to the park. Those events occur only a few times a year. They are not generally regarded as a serious air pollution problem.

Mr. **Vento**. But they do impair the visibility in certain vistas?

Mr. **Chandler**. Yes, sir, they do. We do receive some visitor complaints, although it is not an overwhelming number.

Mr. **Vento**. Of course, the bottom line is, how do you measure the economic damage from that. It, I expect, is not a well-defined method available to do so.

Mr. **Chandler**. Yes, sir.

Mr. **Vento**. And the same is true, for instance, in Sequoia, I expect.

Mr. **Evison**. I would say so.

Mr. **Vento**. Let me recognize the gentleman from Missouri, Mr. Emerson.

Mr. **Emerson**. No questions.

Mr. **Vento**. The gentleman from California, Mr. Lehman.

Mr. **Lehman**. Thank you, Mr. Chairman.

I would like to state for the record, anybody who wants to see air pollution in the vicinity of Sequoia/Kings Canyon Park can come down to my office. I have a very vivid picture that I took, one looking east toward the clear great western divide, and the other from the same point looking west toward the San Joaquin Valley. And you can't see anything out to the valley it's so covered in the smog. But the mountains in that picture are still clear.

Generally there is a ring. You can see ,t from the valley at about 9,000 feet. It's like a bathtub ring up on the mountains above us.

I want to ask you about a couple of things, Mr. Evison. First, I am concerned about the impact of air quality on the giant sequoias. I want to know if you are doing anything specifically to study them.

Mr. **Evison**. Yes. Having observed the impacts of ozone on the yellow pines and black oaks, there was some work done to see whether or not it was affecting the giant sequoias, which is, of course, one of our principal concerns. There will be work done this summer in fumigation chambers set up in Giant Forest with sequoias seedlings to see if there is actually damage being done to the sequoias.

Mr. **Lehman**. So, you have studies going on? You don't have any results yet from that?

Mr. **Evison**. That is correct. I think the earlier studies were done away from the park with sequoia seedlings. The results were not all that clear. That is why they have decided to move into the park.

Mr. **Lehman**. Also, I noticed in the CRS document we have on the documented impacts of acid rain with respect to Sequoia. It says: temporary increase in lake acidity. What does that mean?

Mr. **Evison**. On at least one occasion in our high elevation study site there was, I think, a 2-inch rainfall during the summer, during which time, as I understand it, the acidity didn't increase but the buffering capacity of the lake was reduced to virtually nil. Had that gone on for any longer or had it involved much lower ph, there could have been pretty severe changes in the lake ecosystem.

Mr. **Lehman**. Was the fact that you referenced one lake due to the fact that it only happened at one lake? Or is that the only lake you monitored?

Mr. **Evison**. That's the only lake that we monitor on anything like the level of intensity that we do there.

Mr. **Lehman**. I have been up there before. A helicopter will fly over. One time at Pear Lake a helicopter landed, and some people got out and took water samples. Is that part of an acid rain study, or is that something else?

Mr. **Evison**. There has been helicopter support for some of the activities carried on in connection with the research in that area, primarily when there is a need for getting something out really quickly for the analyses on it.

Mr. **Lehman**. So, you will send a helicopter in to take the sample?

Mr. **Evison**. That has been done, yes. We try to do it in other ways if we can.

Mr. **Lehman**. Were you under some type of schedule to get those samples out?

Mr. **Evison**. You are getting into something that I am not all that expert on. Basically, what we try to do is attempt to figure out means of getting the work done with as little helicopter activity in that area as possible. But we have resorted to it when it seemed that there was no reasonable alternative.

Mr. **Lehman**. Thank you very much.

Mr. **Vento**. I thank the gentleman.

The gentleman from California, Mr. Pashayan.

Mr. **Pashayan**. Well, I am sorry to run late on your testimony. I do not really have any questions. There certainly is a problem. A lot of the problem is not produced indigenously. It is blown in from the northern part of the State, from the bay area. One county, Fresno County, is now under the EPA's mandate of having to get their automobiles checked. There was a great furor because they felt that they were an island of law enforcement, of enforcing the environmental laws in a sea of pollution and troubles. Only time will tell to what extent that will have in reducing the pollution.

Although I was not here to hear all the testimony, I know what the drift of it was. I appreciate your being here.

Mr. **Vento**. I thank the gentleman.

The gentleman from Ohio, Mr. Seiberling.

Mr. **Seiberling**. Thank you very much.

Mr. Chandler, I get the impression that there is no significant air pollution problem in Olympic National Park at the present time. Is that basically correct?

Mr. CHANDLER. Yes, sir, as far as we know. We are concerned about what might occur at Olympic because we have about 30- or 40-percent of the part which is alpine or sub-alpine area, which has soils and rock formation with very low buffering capacities. If we do begin to pick up acid rain or deposition of any kind, it would have an impact on that resource, and we would like to be able to spot it early on.

Mr. SEIBERLING. I certainly think the monitoring is very important for that reason.

Mr. Evison, what would you say appears to be the most serious problem or set of problems with respect to areal pollutants in Sequoia and Kings Canyon?

Mr. EVISON. There is certainly a visibility problem. It is, as Congressman Lehman has said, pretty rare now that you can see the mountains from out in the San Joaquin Valley or that you can see very far into the San Joaquin Valley from up in the park.

There was a time—my secretary is the best source of information on the park known to man, been there for 43 years, tells me that in the 1940's and into the 1950's she and her family used to go up to Giant Forest each year on the Fourth of July to watch the fireworks all over the Central Valley of California, and clear to the coast, she says. It became a geography lesson for her daughters. But in about the mid-1950's they came to the conclusion it was no longer worth going up there. You just couldn't see far enough to see the display.

Mr. SEIBERLING. Would you say the acid deposition is a problem?

Mr. EVISON. I would say that it is very likely to be, but we can't really tell you very much about exactly what the problem is, because we have started with pretty sketchy baseline information about what conditions were back any length of time. We have laid out the research programs being conducted in the park with so much help from outside in a way to establish as broadly as possible the ecosystems information that we need to judge at least in the future.

Mr. SEIBERLING. Do you feel you have an adequate program now? Do you really think you should have more going into it?

Mr. EVISON. Well, we would like to see more go into it. We think certainly more work needs to be done on dry deposition. There is at least an effort being made to determine what the best way of approaching that is.

We need to do more work probably in looking into the effects of acid precipitation on various elements, particularly the animal side of the ecosystem, from plankton in the lakes and invertebrates in the lakes and in terrestrial ecosystems all the way up through the vertebrates.

Mr. SEIBERLING. How much more would it cost to do the job?

Mr. EVISON. I am not really sure of that.

Mr. SEIBERLING. Could you give us an estimate later on for the record?

Mr. **Evison**. I could ask. We have Dr. David Parsons, who is on the science staff assigned to the park, who might be able to give you a better idea of that.

Mr. **Parsons**. I think we have to put this question in context slightly. Superintendent Evison made the point that the acid precipitation research program going on in Sequoia is part of a large cooperative effort. The Federal dollars coming through the Park Service are actually a very small portion of this. Less than 10 percent of the total funding, I would say, that is going into this has come through the Park Service. The great majority has come through the State of California, with other pieces coming from the Electric Power Research Institute, local utility companies, from NASA, from the University of California; and it goes on and on. It is an unprecedented cooperative study, I think, between different kinds of groups.

There are some major holes still in the study, there is no question about that. Managing the kind of data bases that are coming in is going to be a major challenge. We do not have the computer facilities or the data management type expertise in our staff to handle the kinds of large data bases that are going to be coming in. These involve atmospheric pollutants. They involve ecosystem property, soils data, vegetation data, aquatic data, et cetera.

Our biggest concern financially, I think, is the future: where is this going to go after these relatively short-term funding programs, the 5-year State program and the 10-year Federal program, which is just about through its fourth year already, as they wind down? Are we going to be able to continue or have any funding to continue monitoring into the future?

So, I would say in the short term we have several pieces of data and holes that are going to take—well, we have identified a need in the neighborhood of about $150,000 a year to really round out what we feel over the next 3 or 4 years would establish that database.

In terms of the long-term monitoring program, to really make this valuable to future generations, we are going to need, in today's dollars, probably in the neighborhood of 100,000 a year, which is approximately what we current get through the NAPA program on a continuing basis.

Mr. **Seiberling**. Thanks. That doesn't seem to me to be a staggering sum, compared to what we have to deal with around here, although when you add in a similar sum for a lot of other parks, you are beginning to get into some real money.

Mr. Chandler, let me ask you the same question. Do you feel you have an adequate monitoring program now?

Mr. **Chandler**. I do not. I would like to see more monitoring in the park, particularly on the east side, which is in closer proximity to the Puget Sound, the Seattle metropolitan area, about 60 miles away. We have no monitoring underway in the east side of the park at all. We are looking at the western slopes, which we know are the cleaner areas. So, we really have no basis to compare east to west to see the differences.

Mr. **Seiberling**. How much would that cost?

Mr. **Chandler**. I don't have a figure on that. I would have to go to our technical staff and ask them.

Mr. **Seiberling**. If you could supply that for the record, we would appreciate it.

Mr. **Chandler**. I would be pleased to.

[**Editor's note**.—At time of printing, the Department had not yet supplied the information requested by Chairman Seiberling. When received, that material will be placed in the committee files of today's hearing.]

Mr. **Seiberling**. Is the State giving you any assistance comparable to what California is giving Mr. Evison?

Mr. **Chandler**. The only State assistance we have is the monitoring station that is in Port Angeles, near our park headquarters. They provide all of the operating costs for that. We get the data. So, to that extent, they do.

Mr. **Seiberling**. I have no further questions, Mr. Chairman.

Mr. **Vento**. Thank you. I don't want to get into another round, but the point is, I guess, just generally, Mr. Evison, do you feel that the law adequately protects the resource, Sequoia National Park?

Mr. **Evison**. I really am not sure. I just don't know that much about the law. I know that there are some things about the Clean Air Act and its amendments that would enable us to take action if certain things happen. When I have indication that there are major new sources of pollution that might come on line, I turn to people like Molly Ross and our solicitor's office to determine what appropriate steps might be taken.

Mr. **Vento**. I notice that in the wet deposition that there was acid rain, as acid as 4.1 in 1982. Is that the point where you had this 2-inch rainfall? Was it in 1982 that you had the 2-inch rainfall that used up the buffering capacity or not? Do you recall?

Mr. **Evison**. I think that occurred last year.

Mr. **Vento**. Well, that data we don't have here yet. Apparently it hasn't been reproduced.

Mr. **Parsons**. Could I comment on that, Mr. Chairman?

Mr. **Vento**. Yes.

Mr. **Parsons**. That event was a 4.2 rainfall last July, late July, which is a very unusual event in California, where we have the long dry periods in the summer usually. We actually have record pH's as low as 3.7 in our weekly samples. I am not sure of the source of the data you have, but I think it needs to be corrected. And that was back in 1980, I believe, also in the summer and fall.

Mr. **Vento**. This data, I don't know, maybe it's an average data on some particular basis——

Mr. **Parsons**. That may be.

Mr. **Vento** [continuing]. On a monthly basis. For 1980 I have data that the band is 4.7, I would say, to 5.4. In other words, the pH levels in the West tend to be much higher, but nevertheless the tolerances—do you believe, for instance, that Sequoia or that the Olympic National Park has any areas that have a greater degree of sensitivity? Do you have any information on the sensitivity of any specific areas within those parks, either of you?

Mr. **Evison**. Well, we know that—my understanding is, anyway, that in general Sequoia and Kings Canyon is one of those areas in which there is a pretty high degree of vulnerability because of the thin soils and the low buffering capacity and that kind of thing. Probably it is particularly true at the higher elevations.

Mr. **Vento**. In other words, you don't have a lot of carbonates, a lot of limestone formations, and the soils are weak in terms of alkaline ability, right?

Mr. **Evison**. I believe that is correct.

Mr. **Vento**. Mr. Chandler.

Mr. **Chandler**. That is also true at Olympic. The most sensitive areas are the subalpine, alpine areas which have very short growing seasons and low buffering capacity. In addition, we have 11 rivers that flow out of the park that support anadromous fish. We are very concerned about any effects that would reduce the habitat or effect the habitat of salmon and steelhead.

Mr. **Vento**. They tend to be sensitive to change in pH, the salmon and various species that are in those streams?

Mr. **Chandler**. While I am not an expert on that, from what I have read and from what our technical staff tells me, looking at some of the effects of acid rain in Norway and Sweden, where the populations have been really disturbed by or in some cases wiped out nearly by acid rain, it is again why we feel we need to have indicators to find out what might be happening to those aquatic systems.

Mr. **Vento**. Very good, gentlemen. I have no further questions. The gentleman from California has no further questions. We want to thank you for being here. I think your testimony has been very helpful. We are going to continue now with this number of superintendents that are here.

The next panel that I would like to call is Mr. John Cook, who is the Superintendent of the Great Smoky Mountains National Park, and, Mr. John Morehead, who is at the Everglades National Park in Florida. It is a pleasure to welcome you, Mr. Morehead. It is good to see you. I was with Congressman Seiberling on a field visit to the Everglades. I am happy to see you in Washington. Thank you again for your efforts to provide us with a good opportunity to visit that great resource. I think it is a wonderful resource.

PANEL CONSISTING OF JOHN E. COOK, SUPERINTENDENT, GREAT SMOKY MOUNTAINS NATIONAL PARK, AND JOHN M. MOREHEAD, SUPERINTENDENT, EVERGLADES NATIONAL PARK

Mr. **Vento**. You have no prepared statements, but let me proceed to ask you these questions.

We will be talking about the vegetative impacts of air pollution, the aquatic, and visibility impacts also. So, I think that we want you to feel as though you are free to comment. We are looking at, the main theme of these hearings, of course, is the total effect of air pollution on our national parks and I suppose, in summary, whether the law is adequate, what impact you have noticed. No one knows these impacts better than persons like yourselves who are working on a day-to-day basis in these areas. I think sometimes you can't always bring to the front all the scientific data, but obviously, insofar as it is there, I hope that you will refer to it.

What types of monitoring programs do we have in your unit, Mr. Morehead, with regard to these air pollution problems that I have outlined? Do we have them on aquatic, on vegetative, on visibility, and so forth and so on?

Mr. **Morehead**. We have several, Mr. Chairman. We have the two monitoring stations, one to monitor the levels of sulfur dioxide and ozone in the air. We just started that station up sometime this month. So, that is very recent data. We have no results from that monitoring as yet.

We do have an acid deposition monitoring station that has been in place since 1980. Because of the limestone substrate of Florida, we feel the acid precipitation that actually reaches the ground has very little, if any, damage to the flora and fauna. We are concerned, though, with the——

Mr. **Vento**. You haven't noticed an increase in the amount of gypsum around?

Mr. **Morehead**. No; we have not, sir.

We are very concerned about potential aspects of acid rain on the epiphyte plants, the orchids and lichens, and we have recently started studies to measure the effects.

The third monitoring that we have is an informal, within-the-park monitoring station for visibility.

Mr. **Vento**. Someone Suggested to me once that we ought to send all the sulfuric acid that is produced by the scrubbers down to Florida so we could increase the gypsum. We could get into a business here.

Mr. **Morehead**. We'd like to keep that in the northern part of the State, sir.

Mr. **Vento**. The other Superintendent, Mr. Cook, do you want to briefly describe for the committee the monitoring programs that you have, the age of them, and——

Mr. **Cook**. Yes, Mr. Chairman. In addition to the ongoing monitoring programs—and we do have several—we have got about 120 air quality related studies done in the Great Smoky Mountains over the last several years. We currently have, I believe, about 35 scientific studies ongoing that relate to air quality. We are monitoring for the five basic issues. I brought some visuals which I would like to show you: Ozone, SO_2—and, of course, one of the big things with regard to the Great Smoky Mountains is visibility, because that marvelous blue haze from which the Smokies got their name is no longer blue, nor is it dominated by natural emissions. It is now, as we can show you, gray, and you cannot see forever.

Mr. **Vento**. Well, we will have the clerk in a moment bring up the photographs so that I can take a look at them. I don't know if I could see them from here.

We had had that report yesterday. How many sites is it, 30?

Mr. **Cook**. They are not 30 sites——

Mr. **Vento**. Thirty activities going on——

Mr. **Cook**. There are 35 activities.

Mr. **Vento**. I want you to explain a little bit what the source of those efforts are.

Mr. **Cook**. Well, like my colleagues, who testified earlier today, if it weren't for others' involvement, I don't believe our $300,000, what we are putting into, say, this year, would go very far. However, the Smokies being what it is, such an important place. Oak Ridge National Laboratory is involved. TVA is involved. The U.S. Forest Service is involved. The State of North Carolina, the State of Tennessee are involved. In other words, we have a large cooperative effort going on in the Smokies. In fact, there is about $8 million worth of scientific study going on related to this issue.

Mr. VENTO. How about the State of Florida, are they concerned? I know they are trying to put out a few fires this weekend, which you are very unhappy about, I am sure, in terms of 100,000 acres lost. What about their efforts with regard to your work in the Everglades? Have they come forth?

Mr. MOREHEAD. Yes, sir. Both the State and Dade County are cooperating and are monitoring studies as far as calibration and training our people and helping us purchase the equipment. I think our significant input from outside is from Florida Power & Light. They are financing approximately 50 percent of the 10 ongoing research studies we have to measure the actual effects of potential air pollution on the sensitive plants.

Mr. VENTO. In looking, Mr. Cook, at the photographs that you shared with us, I guess the questions come, and you, of course, led into it in terms of the visual pollution that is occurring there, which is, I think, pretty graphically documented with these photographs, I don't think that there is any question but that that is the case. Of course, as you know, you were preceded by Senator Sasser, who reported the fish kill outside the park apparently. And I don't know if it was 5,000 or 50,000.

Mr. COOK. If I recall the specifics of the report, it was 1983, I think it was 50,000.

Mr. VENTO. I think so, too. I think that colleague from California misspoke. I will direct that comment to his staff. They missed a zero.

In any case, I am glad that that question came up and was asked, quite frankly. In looking at that and in looking at these photographs, these wonderful photographs that you shared with us, you indicate a lot of fir kill there from aphid. Of course, this points out that seldom do these factors like the ozone damage which has occurred in the Great Smoky Mountains and is documented—correct me if I am wrong—but seldom do those things occur alone. In fact, they usually occur in conjunction with other activities that are going on. It might be a lack of rainfall. It might be an infestation of various types of insects or other types of pests. When that occurs, the plant has been substantially weakened. Then obviously the result, rather than shaking off some sort of an infestation, actually results in the dieback of potentially a valuable resource, whether it's park or forest, and so forth and so on.

That is the point, I guess, that is made here with regard to that. Generally air pollution is but one factor of stress that is being visited upon the Everglades and being visited upon the Great Smoky Mountains. Is that the point?

Mr. COOK. Absolutely correct, Mr. Chairman.

Mr. VENTO. Can you see other combinations of where that has worked together with regard to aquatic, I guess other vegetative impacts, and so forth?

Mr. COOK. We are beginning to find that information. I wish we had been doing the baseline studies many, many years ago. We are finding out new things every day. We found just this year through fumigation studies that the manna grass, which grows only in the Great Smoky Mountains and is a rare plant, is in fact being overcome by ozone. We are finding in some studies we are just starting with salamanders that a high pH level in the stream following a rain, the salamanders hotfoot it for high ground. They want to get away from the pH factor.

We are learning more every day, Mr. Chairman. But there is no question in my mind nor the mind of my scientists that there are connecting effects that even Mother Nature alone through a change in rainfall pattern, the tree might be so stressed that it can't recover due to a lack of moisture one year.

Mr. VENTO. Nobody would want to hurt those little salamanders. How about the alligator population in the Everglades?

Mr. MOREHEAD. I think they are very stable, sir.

As John Cook points out, our studies are really just in their beginning. We are interested, too, in the cumulative effects and how these different pollutants affect one another on the biology. But at this particular time, we have no hard data to show that we have a significant decline in our resources.

Mr. VENTO. It sounds as though Dade County and the State of Florida had—I was very impressed when I was in Florida, incidentally, with the water resources work that was done at the State level, and still am. I am surprised that we had to take some of our best lake scientists and bring them up from Florida or at least we lost them to Florida vis-a-vis Minnesota. We have more real lakes, you know, not just potholes below the ground level.

Mr. MOREHEAD. I see.

Mr. VENTO. Clay basin type of lakes, some 15,000, I might add, in which there are far too few walleyes.

The point is that there are some. The county and State have done some data. Has that been useful to you? Does that indicate anything within the park? Or hadn't they had sites within the park before? You said there were some 10 sites in the park.

Mr. MOREHEAD. Ten studies, sir, and those are very recent.

I think probably more significant are the regulatory steps that both the counties and the State have taken. The Florida State implementation plan was submitted quite early. The entire State was designated as a prevention of significant deterioration area. The county and the State now are working on some visibility requirements.

I think the State has been very progressive in the regulatory control of air pollution.

Mr. VENTO. Any other air pollution, of course, we haven't dealt with, but what about toxic chemicals? Either heavy metals or any type of pesticides, and so forth? Are there any problems like that in Florida?

Mr. MOREHEAD. Sir, we had an indication from a study back in 1973 and 1974 that some of the invertebrates and marine animals may have had high levels of mercury and arsenic.

If you will recall the history of the hole and the donut farming area within the park, that area was being farmed intensively, about 12,000 acres of it, during the time that those studies were made. I have not reviewed that study really carefully recently, so I can't say if that heavy metal deposition found in the animals was due to agricultural spraying at that time or not. But as of 1975, that farming was stopped in the park. So, I don't think that the heavy metal indicated by that study is a result of an existing air pollution problem.

Mr. Vento. Of course, one of the problems, as we all are aware, the alkaline capacity to neutralize, but the question is, in the process of neutralizing, do you free up heavy metals in terms of that limestone, and so forth? I don't know if anyone has done an analysis of it to determine what the effect would be on its buffering capacity.

Mr. Morehead. Well, it's an immense buffering capacity. Because of the volume of water that flows over the entire Everglades, I would suspect that there is not a significant adverse effect.

Mr. Vento. From just the acid rain. But the question is in terms of free metals, it might be in the limestone itself as it turns to gypsum.

Mr. Cook, what about any exotic heavy metals, any other pesticides, herbicides that have been noticed in the Great Smoky Mountains, any impact from that?

Mr. Cook. We are beginning to get some indication that there might be some heavy metal. The very preliminary data was just made available to myself and my staff within the last few months. So, it is really premature for me to testify to the fact other than there appear to be indicators pointing in that direction.

Mr. Vento. Is that being freed up or is it being delivered by, for instance, the air?

Mr. Cook. It, in all likelihood, would be being delivered. But again it is really premature to do anything more than say it's a yellow light and we need to look much more closely at it.

Mr. Vento. Well, I agree that is the case.

Mr. Cook, what is the case with regard to the Smokies? What is the State with regard to the Clean Air Act? Are you a class I area?

Mr. Cook. We are a class I area; yes, sir.

Mr. Vento. So, you have the PSDI requirement as well, prevention of significant deterioration. In the permitting process, are you called upon from the Department of the Interior from time to time and notified of problems, activities that are going to go on from point sources in and around the area?

Mr. Cook. Well, like my friend and colleague, Mr. Evison from Sequoia/Kings Canyon, when I either am asked about or find out about a potential problem, I immediately contact Molly Ross and our attorneys. In all candor, yes, we have participated through the Air Quality Office, Ms. Ross, in commenting back to Tennessee with regard to air quality standards and air quality needs.

Mr. Vento. You have apparently been part, in your role as Superintendent here and perhaps in other areas, as I know you have come here recently, according to when Mr. Hendon had mentioned, someone else had been there earlier, had played a role in terms of making assessments as to what the effect would be in the park. Is that solely left to you? Does your recommendation generally go to Ms. Ross and is followed up?

Mr. Cook. Well, it is not solely left to us. I believe we have an obligation as the stewards of national parks, those of us who are superintendents, if we are aware of something, to make others within our organization aware of it and ask for the technical and professional expertise that is available through Dr. Briceland's office, and make our own comments through the appropriate channels. So, we are active, I believe, in a reactive mode as well as a proactive mode.

Mr. **Vento**. It is difficult, I guess, to act out this role if you don't have baseline data. In other words, you are going on the basis of, I guess, educated hunches.

Mr. **Cook**. Unfortunately, I am afraid, all too often in the past we have had to go on educated hunches. I don't think they have been all that bad, but they have difficulty holding up in court. That is why I believe the sound data that we are gathering, and I believe we need it. I believe we need it in the old-line parks. I believe we need it in the Alaska parks.

Mr. **Vento**. I do, too. I think that that is important because, obviously, whenever we might make judgments about these, the bottom line is, under the law—and I don't think it has to be so different if the law were structured differently anyway—is that you have to be able to demonstrate where you are at and what the deterioration might be from a single point source.

Have you any indications of what is happening with the buffer capacity in the Great Smoky Mountains in terms of acidic deposition?

Mr. **Cook**. I would have to refer that to Dr. Peine.

Mr. **Vento**. Fine.

Mr. **Cook**. He is my chief scientist.

Mr. **Vento**. OK.

You are?

Mr. **Peine**. John Peine.

Jim Galloway's testimony yesterday really answers that question for the Smokies as well as Shenandoah, where he did the research. He indicated that he believes that, if you count by decades, within one or two or three decades, there is very likely to be a period of saturation of the sulfate in the soils. I think that that is a potential time bomb possibly, in terms of the aquatic resources in these mountain streams. They are very vulnerable to acid deposition. They are very vulnerable to pH depression. If the soils become saturated, then there will be a much higher level of acidity going into those streams.

It hasn't been proven to occur yet, but his studies certainly point to the potential in the future.

Mr. **Vento**. One of the chief problems that is most recognized with the Great Smoky Mountains is the one that the Superintendent alluded to. That is the question of visibility, in other words, what has been the trend with regard to visibility in the park? Dr. Peine or Mr. Cook.

Mr. **Cook**. The research to date indicates there has been at least a 30-percent deterioration in the air visibility of the air quality there in the last 36 years.

I passed up to you that one exhibit. We are continuing to document the visual impacts of the airborne particulates. But it has deteriorated at least 30 percent in the last three decades.

Mr. **Vento**. The scientific information, that is primarily sulfates, I expect. Is that correct?

Mr. **Cook**. That is correct.

Mr. **Vento.** Has there been any remediation recommended with regard to that or any way that that can be changed, do you know, through the States or through the national Government actions?

Mr. **Cook.** Frankly, Mr. Chairman, I believe that is a problem that is out of my league, other than to say that we recognize that it is impacting upon the park I am responsible for. Information brought to me via the scientists is that it is beyond even a regional problem, that it is definitely something that will take far greater minds and actions than my own.

Mr. **Vento.** Did you bring along a photograph of a tree ring today? I guess you have that there. I don't know if you referred to it. What is the representation? Why don't you hold that up there so that I can get an idea? How old is this tree?

Mr. **Cook.** The tree was born in 1825. You can see it is very standard growth patterns.

Mr. **Vento.** I have a photograph of it here.

Mr. **Cook.** The standard growth patterns in 10-year increments until about 1967, when, according to the scientists, it began to be stressed.

Mr. **Vento.** What type of plant is it? Is that a spruce?

Mr. **Cook.** Red spruce.

From this point on, the growth shows that the tree is stressed, and whether it will recover, whether it will become susceptible to other hosts are things that we don't know but we suspect. But this is obvious that something has affected this and many other trees. This is just one example.

Mr. **Vento.** This, you think, was typical of an example of a stand of red spruce that existed? They are in a mixed species, are they not?

Mr. **Cook.** Yes, but it is very typical.

Mr. **Peine.** The focus on the red spruce has just recently gotten a lot of funding through the NAPA program. It is one of the tree species originally in New England that was identified probably 5 years ago as being in a severe state of decline. There is a lot of debate as to what causes the decline among scientists. But the pictures that you have in front of you, Mr. Chairman, show the kinds of symptoms that do occur. With the great decline in the growth rate, the rings, the dieback from the top of the tree, and the thinning from the inside out of the needles. We see that particularly at the very high elevation, around the Clingman's Dome area, about 80 percent of the trees exhibit some form of this. It drops down to 40 percent at lower elevation.

Mr. **Vento.** Eighty percent of the trees exhibit this particular——

Mr. **Peine.** Of the red spruce. This is primarily a symptomology of the one species.

This tree is codominant with the Fraser fir that is under siege by the balsam aphid. The mortality there is very high. The spruce fir zone in the park is what makes it so special and gives it the great depth of diversity of flora that has made it world renowned. I think that these two codominant species are under quite a bit of stress. If you look at the lessons of Europe, when the trees exhibit this nature and this degree of stress, it isn't a matter of all that many years, 4 to 5 years, before it follows with a fairly high rate of mortality. We haven't seen that yet.

Mr. VENTO. The Black Forest has spruce. You take a cross section through those, and you look at the growth rings. They would look not unlike this. Is that the case?

Mr. PEINE. That is correct. Ellis Cowling, who was here yesterday, is probably the best authority in the country on those relationships.

Mr. VENTO. I know that later, Dr. Peine, you are going to testify with regard to this. I think it is important to note the ozone damage that is occurring here and the similarity at this time. The superintendent has introduced the problem of visibility, the problems of aquatic ph changes, and, of course, the species effect on red spruce and on fir.

This is very interesting because, while I know that everyone here cannot see this, it shows that those branches and needles that are most exposed in terms of the spruce are those that are most damaged. Those near the top, you can see the ozone, the yellow marks in there, which are the tell-tale mark of ozone damage, according to our plant pathologist yesterday. It shows the absolute correlation between this and, of course, the growth rings.

I suppose the German scientists discovered this back in the 1970's. We are looking at it in the 1980's. I guess the question is whether by 1995 we will have any change or whether the Smokies will be—when you say 80 percent of the plants in the higher elevations, 40 percent of the plants in the lower elevations, red spruce, are showing this. Now, other signs of stress on the fir are the aphids, in conjunction. But if something else comes along like forest fire or anything else, it will cause a great deal more damage in this particular instance with this amount of dieback and so forth and dead wood. Isn't that correct?

It becomes vulnerable to just about any type of environmental or ecological stress that is placed upon the plant.

Mr. PEINE. It is more than just that individual tree. Because it is dominant, it drives the ecosystem. So, all the other herbs and the small mammals and everything else that live in that environment are likely to be affected because of the fact that you are dealing with the two dominant tree species in that high elevation.

Mr. VENTO. This is, I think, absolutely the type of thing we are seeing, damage to our national parks in terms of air pollution. I think it has to be corrected, whether it is within or without the ambient standards.

I think you are right, Mr. Cook, when you point out that it is something that goes beyond the boundaries of the State and maybe even the Nation.

Mr. PEINE. The reason for the gradient by elevation, in effect, many scientists believe are related to cloud interception at the mountain tops and the fact that the clouds are heavily laden with pollutants that are potentially many times greater than what you might find in acid rain.

Mr. VENTO. Poison clouds, poison in terms of air pollution moving in in clouds, I guess.

Mr. PEINE. Yes.

Mr. VENTO. Absolutely a disaster.

The gentleman from Utah, I don't know if he has had the chance to catch his breath, running back and forth. I appreciate his appearance at the committee. We have two superintendents here at this time, Mr. Cook and Mr. Morehead from the Everglades. Mr. Cook is from the Great Smoky Mountains. The gentleman from Utah.

Mr. **HANSEN**. Thank you, Mr. Chairman. I apologize to the committee. It is tough in this job to choose between which committee you are supposed to be in, and it is hard to cover all the bases. I apologize to you for that.

I will read your testimony. But I would like to ask Superintendent Cook if he wouldn't mind responding to a question that Mr. Lagomarsino brought up originally. It has been dwelling on my mind since I walked out of here regarding that fish kill which you said was outside of the park. Was that really due to acidity? If we were going to go for tort liability, would the proximate cause there be the acidity that we would lay that on? Or would it be something else?

In other words, if you were in court and you had your arm to the square and as an expert on the subject, would you testify that this was definitely caused by some type of acid rain, and they just said, give me a yes or no answer, how would you handle that?

Mr. **COOK**. Well, I believe, inasmuch as I wouldn't have to testify as an expert witness, I would evade the question.

However, Congressman, the information that came as a result of this fish kill—and there was a severe fish kill at a fish hatchery—was developed by TVA scientists. Their study, which was made available to the Cherokee and to us, indicates that it was the ph factor that killed the fish. And the point source of the ph factor was Raven's Creek, which was flowing out of the park, and that it was subsequent to a nominally heavy rainfall.

I don't believe even the scientists would say acid rain killed the fish.

Mr. **HANSEN**. I see.

Yesterday, the Senator from Tennessee, Mr. Jim Sasser, who gave a very interesting presentation about the Great Smoky Mountains and talked about the air quality problems there.

How long have you been the superintendent of that park?

Mr. **COOK**. A little over 2 years, sir.

Mr. **HANSEN**. Have you noticed a decrease in visibility or increase in the amount of particulates? We were looking at some very interesting photography yesterday that they had done on the area. I have often been a little hesitant on those things. Having a little familiarity with the parks in the West, it seems like you can take a picture about a certain time of the day when it looks obscure 1 minute and then 20 minutes later, it's not.

I just wondered what was the actuality of that. It's just like the time that you take a picture, it sometimes has quite a bearing on it. I am sure Mr. Marks will comment about the Grand Canyon. I intend to ask him some questions about it. That place is such a photographer's heaven, so to speak. In the Grand Canyon you can get about any type of picture that you want. A lot of that is predicated on the time that you take it, in the morning, evening, or night.

What I am getting at is this. Have you noticed any increase of what you would say would be particulates in the air or things that would stop a person's view of the canyon? Just from the layman's viewpoint, could you answer that?

Mr. **Cook**. In the 2 years I have been there, Congressman, I could not say I have seen a plus or a minus change in the visual qualities of the air. I can say that the information we provided the committee and others with regard to the photograph for the Great Smokies has been done in a very straightforward and a very, very well documented manner so as not to make it make a case one way or the other. It is done out of the Look Rock Station and it is done in cooperation with the State of Tennessee. The pictures are taken at the same time of days. It doesn't matter what the weather is. So, we have a variance. They are bad summer days. At 1 o'clock in the afternoon on a bad summer day with an air inversion, the visibility is going to be impaired.

People who have personal eyewitness feelings or observations about it will tell you it has deteriorated. The studies done through the U.S. Weather Service and TVA indicate that there is a quantifiable deterioration of the visuals.

Mr. **Hansen**. Do you monitor in the Great Smoky Mountains?

Mr. **Cook**. Yes, sir, we do.

Mr. **Hansen**. Does your monitoring show that also?

Mr. **Cook**. Yes, sir, it does.

Mr. **Hansen**. Do you agree that many times that you can be in an area, either as a boatman, pilot, backpacker, riding a horse, where you can see different fronts come along that sometimes give the same impression? Taking the wind river area, for example, a front could come along and almost obscure it, and if you were to take a picture of it, you could almost think you are taking a picture of a burning barn or something. Do you agree that happens?

Mr. **Cook**. Certainly.

Mr. **Hansen**. Would you further agree that photography could be taken that way that would almost give you that same impression?

Mr. **Cook**. It could be, if it was not done in a continuing controller manner; yes, sir.

Mr. **Hansen**. Thank you, Mr. Chairman.

Mr. **Vento**. Thank you. These are questions we did explore with staff and so forth prior. So, I think these photographs, of course, we have to accept as having a certain validity and reliability concerning these matters. I think that, even though we are sometimes within the ambient air quality standards, there still is this problem that exists with regard to the visibility.

Mr. Morehead, Mr. Cook, and Mr. Peine, we are going to hear from you a little later this afternoon, maybe early this evening, the way I am going. We appreciate your testimony, and you are excused.

We will resume our sitting in about 1 hour, at about quarter of 2. I look forward to hearing from the other panels of superintendents.

Thank you all for your participation. The meeting is in recess.

[Whereupon, at 12:55 p.m., the subcommittee was recessed, to resume later the same day.]

AFTER RECESS

Mr. Vento. The Subcommittee on Parks and Recreation will resume its sitting on its continuation of the oversight hearing on air pollution in our national parks.

The next panel that I want to call includes Mr. Richard Marks from the Grand Canyon National Park, Mr. Robert Heyder from the Mesa Verde National Park in Colorado, and Mr. James Thompson, Rocky Mountain National Park, and Mr. Bill Malm, who has not been on the panel but is one of the scientists that has background in visual pollution. He will be joining that group and this panel.

Please come to the witness table, gentlemen.

PANEL CONSISTING OF RICHARD W. MARKS, SUPERINTENDENT, GRAND CANYON NATIONAL PARK; ROBERT C. HEYDER, SUPERINTENDENT, MESA VERDE NATIONAL PARK; JAMES B. THOMPSON, SUPERINTENDENT, ROCKY MOUNTAIN NATIONAL PARK; AND BILL MALM, RESEARCH PHYSICIST, QUALITY DIVISION

Mr. Vento. There is an agreement struck here that there would not be written or submitted testimony but that the superintendents would respond to questions. We have all of our superintendents here, I guess. I haven't had the privilege of meeting all of you. So, Mr. Marks, if you would identify yourself, and then by process of elimination we have Mr. Heyder. And Mr. Thompson, it is good to greet you and welcome you to the committee.

You are in charge of some important resources, of course, all the superintendents are. These three, I am sure, stand out as being some of the most important, certainly some of the most extensive national parks that I have responsibility for.

Let's start with Mr. Thompson and the Rocky Mountain National Park. Maybe he would like to explain the monitoring programs that are in place. Then in turn I will ask the other superintendents, Mr. Marks and Mr. Heyder, to do the same. And then we will talk about some of the specific points. Mr. Thompson?

Mr. Thompson. Mr. Chairman, the monitoring program at Rocky Mountain National Park has consisted for the past 5 years of primarily visibility monitoring readings and collection of fine particulates and part——

Mr. Vento. How many monitoring sites, Mr. Thompson, do you have there?

Mr. Thompson. There are two NADP sites in the park: One at headquarters and one in the back country of the park at one of the alpine lakes.

Mr. Vento. And State participation, does Colorado have a program that they are doing any monitoring in your park?

Mr. Thompson. The State, of course, is cooperating with the service, primarily through the Air Quality Office. But we don't have any direct activities involving the State within the park.

Mr. Vento. And nothing in the immediate vicinity? Does the State of Colorado, to your knowledge, have a separate Air Monitoring Program?

Mr. Thompson. They have a very aggressive program. I think one of the differences perhaps with some of the other parks is that much of the activity of the State has concentrated on the western part of the State, including some of the National Park Service areas there and also the Denver metropolitan area, where they have quite a serious problem. We have not had a great deal of activity in the part of the State within Rocky Mountain National Park.

Mr. VENTO. In any areas in the immediate vicinity?

Mr. THOMPSON. Well, the park——

Mr. VENTO. In other words, what I am getting at is, is there any data that is applicable that is useful to you in the area that the State is doing?

Mr. THOMPSON. Well, yes, there is. The park, of course, is quite close to Denver. It is only 60 miles away and, in fact, much closer than that, the part of the metropolitan area that contributes to the very intense pollution that lies along the front range. That is the source of some of our pollution in the park on occasions. So, the work that the State is doing in that area is very pertinent.

Mr. VENTO. How long has the monitoring been going on in your park through the national program, since when?

Mr. THOMPSON. About 5 years.

Mr. VENTO. So, since 1979-80. Do you think that that monitoring is adequate within the park?

Mr. THOMPSON. The monitoring that we are doing on visibility is done only on the east side of the park. The park is split by the continental divide. The conditions on the west side of Rocky Mountain National Park are very different from those on the east. We are not doing any monitoring on the west side of the park.

Mr. VENTO. How big is this park?

Mr. THOMPSON. It is about 400 square miles. It ranges in elevation from 8,000 to 14,000 feet.

Mr. VENTO. What portion of the park would not have monitoring activity on it then?

Mr. THOMPSON. There is nothing going on in the west side of the park, so roughly 50 percent of the park is not represented. The conditions are so very different from the west side to the east side. In fact, the pollutants are quite different from the west side to the east side. What we are doing is only representative of the east side conditions.

Mr. VENTO. Visibility monitoring is very valuable in this area because it tends to be one of the sore points, one of the places where we see a deterioration. I assume that this visibility monitoring does demonstrate a significant problem?

Mr. THOMPSON. The visibility situation at Rocky Mountain is a very difficult one to describe. It is subject to rather intense winds. The episodes that we have of visibility impairment tend to be affected by those conditions. Probably our most obvious visibility impairment comes when we have upslope wind conditions out of the Denver metropolitan area. On those occasions we do get very visible pollution.

Mr. VENTO. Why is it that they are not doing monitoring for more than visual pollution type of thing? Why aren't they doing the other monitoring? Do you know why they aren't doing the acid rain and the other type of ozone monitoring?

Mr. Thompson. We are doing some monitoring for—well, we have some studies going on on acid rain. As part of the atmospheric, we are doing wet deposition monitoring. There is no dry deposition monitoring. We do have the two sites on the wet deposition. And there are a number of studies that have been done on acid deposition within the park as well.

Mr. Vento. Have you had any episodes or problems with regard to this? How long has that been going on, the wet deposition monitoring?

Mr. Thompson. I believe it is about since 1980.

Mr. Vento. I notice from the preliminary information from 1983 that you had a pH reading at one point an average of 4.0 in 1983.

Mr. Thompson. We have had episodes of 4.0. The trend in that monitoring has shown that in the events themselves, that is, the precipitation pH has been going down on the average, and the lows have been going down each year.

Mr. Vento. What is the buffering capacity of the park environment in terms of acid deposition, Mr. Thompson?

Mr. Thompson. Particularly on the east side of the park at high elevations there is almost no buffering capacity at all. The soils are granitic. It is very acid. There are practically no soils and, in fact, very little weathering. So, you are talking basically about bare rock of an acidic type.

Mr. Vento. There is not much limestone in that igneous and metamorphic rock?

Mr. Thompson. It is almost all igneous and metamorphic. There is no limestock whatsoever.

Mr. Vento. So, there is, in other words, no buffering capacity there?

Mr. Thompson. No buffering capacity from the rock types. There are some soils, and there is a certain amount of buffering that takes place as a result of rapid flushing of high lakes at the high altitudes because of the gradients.

Mr. Vento. So, these areas, I think, that traditionally we had thought of as being the most removed in terms of man, and so forth, now come under these clouds of rain and of acid deposition and are really the most vulnerable of all? Those that we thought were the most secure, I suppose, in terms of being remote and inaccessible turn out to be the most vulnerable of all the environments within the park to this acid deposition. Is that right?

Mr. Thompson. That is correct. They are very, very sensitive at high altitudes to acid deposition.

Mr. Vento. And the alpine meadows are very sensitive to acid deposition?

Mr. Thompson. The alpine meadows are very sensitive. We have a depression in the pH early in the spring when the snow melt takes place. It normally comes back up, but it will drop down to about 5.8. It has been shown that around 5.5, there will be often damage to aquatic life, particularly the insects that fish depend upon.

One of the reasons of our concern there, aside from the general aquatic life in the park, is that we are the area where the threatened species of greenback cutthroat trout has been reintroduced. It was nearly extinct. And it is recovering. It is recovering primarily in the park. In fact, all of the areas where the greenback has been reintroduced as part of the recovery program are in these drainages that are susceptible to this kind of a condition.

Mr. **Vento**. And damage to the insect diet, and so forth, you fear actually will occur? They are very susceptible to a slight change in pH?

Mr. **Thompson**. Well, I wouldn't go so far as to predict that it will occur. We do not have anything at this point that shows a trend in the actual pH level of these high lakes. What we have so far is a fairly stable situation in the short period of time we have been monitoring. However, we do have a decreasing pH in the incoming precipitation.

Mr. **Vento**. At this rate, we are not going to get very far with all the witnesses. I think the questions are good. The answers are excellent.

Let me refer to your counterpart from Colorado, Mr. Heyder, from Mesa Verde National Park. Do you want to explain your monitoring program?

Mr. **Heyder**. Yes, sir. We have five programs in the park; one of them has been carried on since 1974. It is an air quality monitoring program carried on by the Colorado Department of Health. They do limited chemical analysis of particulates.

Mr. **Vento**. Your resource concern is what, primarily? Is this a cultural resource?

Mr. **Heyder**. A cultural resource. Also, natural, too, sir. We have 51,000 acres in the park. They are very interrelated.

Mr. **Vento**. Please proceed.

Mr. **Heyder**. The second one is the air visibility monitoring system that we have from the Farview Visitors Center. That has been carried on since 1978. Readings are taken there a number of times a day to a number of different sites located in southern Colorado and into New Mexico, sir.

The third one is the acid deposition program. This has been going on since 1980.

The fourth, which is the most recent, is a remote automated weather station which we have located right next to Spruce Tree House, one of the famous ruins there at Mesa Verde. This monitors the effect of acid rain on the cultural resources and is quite detailed and developing a lot of data. It was put on line in 1983.

We have now actually about 3 months of actual data that we can use. Unluckily, the first year it was online, it was struck by lightning. We had a setback there. We feel that we are about 3 years away from really a good data base from this particular method of collecting information.

The last one is the particulate matter chemical analysis. This has been going on since 1982. The samples are sent to the University of California at Davis, where they are run through tests.

Mr. **Vento**. Mr. Heyder, can you identify some of the damage that has occurred in your resource, either cultural, vegetative, visual pollution that exists in this resource at this time, based on your own view and that may be supported by some of the monitoring that is going on?

Mr. **Heyder**. There definitely is a problem looking to the south, toward Shiprock into New Mexico. This has been certainly holding its own. I have been at Mesa Verde for 6 years now. I can't see really any appreciable improvement or any more degradation. It is about the same.

They have put on some bag treatments at some of the powerplants. These have been on now about 6 months to 1 year. It is kind of hard to tell whether they are really effective as yet.

To the west, toward the Abajo Mountains, near Monticello, UT, there is certainly I would say, an increase in yellow haze that is noticeable throughout the year. Certainly it is more noticeable in the summer months than in the winter.

It is difficult to assess any damage to the ruins themselves. The reason for this is that we have some 4,000 sites in the park. The great majority of them have not been excavated. They are kind of in a state of moldering away, being covered by natural debris since the sites were abandoned.

Our problem, I think, is those sites that we have excavated. Once we excavate them, we do create problems for ourselves.

Mr. VENTO. In other words, they are then subject to weathering, and they are also subject to the air pollution type of problem that we are talking about. Is that what you mean?

Mr. HEYDER. I would certainly say they are subject to weathering. How much the acid rain would have an effect on them, it is difficult to say. But it is kind of hard to believe that there is no effect.

Mr. VENTO. What is the substance? Is it sandstone?

Mr. HEYDER. Sandstone, sir, yes.

Mr. VENTO. Sandstone, so it's silica, basically. So, the question is how much damage. Are there any carbonates in that type of stone at all?

Mr. HEYDER. Not that I know of. We do have some coal lenses in the area, though, sir.

Mr. VENTO. Some what?

Mr. HEYDER. Coal lenses, coal deposits in the park, very thin lenses.

Mr. VENTO. So, they would be putting out what, a pollutant?

Mr. HEYDER. That I couldn't say, sir.

Mr. VENTO. Let me call on my colleague from California, Mr. Lagomarsino, to proceed with the questioning.

Mr. LAGOMARSINO. Superintendent Heyder, you mentioned early on something about monitoring stations in Mexico?

Mr. HEYDER. New Mexico, sir. The park is located in the Four Corners area. It makes it a little difficult. We are about, I imagine, from the south end of the park, we are about 15 miles from the New Mexico border and about 70 miles from the Utah border, and the same would be to Arizona, sir.

Mr. LAGOMARSINO. Do you have any idea from your testing and monitoring where the pollutions are coming from?

Mr. HEYDER. No, no; I don't. It is difficult to say whether they are generated locally or they are relatively long-range transport. But there certainly are problems in the park.

Mr. LAGOMARSINO. Is there any cause from natural conditions like volcanoes, fires, things of that kind? Has that been a factor at all in your area?

Mr. Heyder. I would say no, as far as volcanoes go. When Mount St. Helens went off, I guess we did have some haze, debris, dust that came in that general area. At least that is what some people claimed.

The first does present a problem to a degree. The Forest Service to the north of us does practice prescribed burning. In certain times of the year that could affect the park. But it would be relatively limited to probably the month of May.

Mr. Lagomarsino. Mr. Thompson, with regard to the insects that you were concerned about in the high mountain lakes, were you saying that there had been an effect on them or only that you were concerned that there would be or could be?

Mr. Heyder. No, sir. There have been studies that have shown that around a pH of 5.5, that aquatic insects that fish are dependent on, May flies and that sort of thing are affected.

The lowest pH levels that we have been getting in our lakes are around 5.8.

Mr. Lagomarsino. So, I gather from what you said that the pH level goes up and down. The high level or the low level—low levels are what we are concerned about—when you have the runoff from the snow melt?

Mr. Heyder. Yes, sir; during the spring. Throughout the winter, of course, there is no water movement or no significant water movement in those high altitude areas because everything is locked up in snow and ice. There tends to be a concentration. During the spring runoff, when it first starts, we get our lowest pH readings, which are down around 5.8. As the runoff continues later in the spring, then the pH levels go up to 6, 6.2, in that area.

Mr. Lagomarsino. How do you account for that? Is there some natural situation that——

Mr. Heyder. Apparently the flushing that takes place at a very rapid rate at these high lakes, with incoming water, begins to dilute these concentrations that have accumulated during the winter.

Mr. Lagomarsino. How far back does your data go in this?

Mr. Heyder. I believe about 3 years.

Mr. Lagomarsino. So, you have no idea what the pH level was before that time?

Mr. Heyder. No, sir.

As I say, we don't have anything in the actual pH of the lakes that could give us a trend at this point.

Mr. Lagomarsino. That is one of the things that you are obviously studying very carefully?

Mr. Heyder. Yes, sir.

Mr. Lagomarsino. Mr. Marks, you haven't commented yet. I would ask you to tell us about the testing programs in your park. What are your concerns there?

Mr. Marks. Obviously, the testing program, as you heard this morning and again this afternoon, since 1978, although there has been some testing done in Grand Canyon since 1959, in this regime has been basically since 1978, not 1968. The concern, obviously, to Grand Canyon is the visible quality as opposed to the natural science side of the things that you have heard about. There aren't great redwoods. It is a desert environment, which is certainly very delicate to stimuli and stresses, as we will talk about in a moment.

The important thing is that people come to Grand Canyon not only from the State of Arizona and the United States but all over the world. And one who comes 3,000 miles to see what they expect to see and it's not there, we do get complaints. And I expect you gentlemen likewise hear about that.

The concern we have is that the canyon is 217 miles long. Thus, the visual quality must be important to see that. Looking at the information over the past several years, it is indicated that there is a degradation of that quality and distance. One would suggest, however, that that quality in distance is greater than in perhaps other places. John Cook spoke of the Great Smoky Mountains.

We look at 30 miles minimum and near 60 miles maximum visibility. But a person looking at the canyon recognizes the difference. The photographs that you have seen have been submitted and reflect the fact that there is at time less quality.

Looking at the visitation that comes from the State of Arizona from either Nevada—many come in that manner—or through Arizona, 80 percent of those people do come in the summer months, when the impact is the greatest. Thus, the concern is seeing what is there, in the sense, I suspect, that 90 percent of the people who do come to the Grand Canyon do so in a very short time, particularly look over the side and look at the canyon. So, we have that concern of visibility, although we do monitor ozone and have monitored that for a time. The pH is very close to, interestingly enough, the pH found at Rocky Mountain National Park.

Mr. **Vento**. I had taken so much time in terms of the first two. I think this issue with regard to the Grand Canyon, of course, is very important in terms of the visual problem.

I guess the question is, you have been doing some wet deposition monitoring of sulfites, of acid rain. What about dry deposition? Now, that would be very, very important in this particular area, wouldn't it? What have you been doing in terms of dry deposition monitoring?

Mr. **Marks**. We have asked Mr. Malm to come explain the program. He has worked at Grand Canyon certainly for the Park Service for the last several years but started his work in 1974.

Mr. **Vento**. Let me see if you have a brief answer to that, Mr. Malm.

Mr. **Malm**. In terms of a brief answer to your question about dry acid deposition monitoring?

Mr. **Vento**. Yes.

Mr. **Malm**. Dry deposition monitoring is not currently, to my knowledge, being carried out any place within the Western United States.

Mr. **Vento**. This is what I was going to constitute as a problem because, of course, it is a significant issue.

Obviously, I am on the chairman's time here. Let me yield to the leading Representative of the Grand Canyon, the gentleman from Arizona, Mr. Udall.

The **Chairman**. I am delighted to attend a small part of these hearings. I think they are very important.

I was saying yesterday this committee over the last 25 years has done a couple of things that I am extremely proud of. Now it all seems to be in danger. We have got to fight the fight all over again. I refer to the doubling of the National Park System. One of the great things in the world is the American National Park System. We buy out the holdings. We get the land. We build the visitors centers. We think we have got this protected.

We put together in this committee the last few years, going back to 1964, a wilderness system that is the envy of a lot of countries. We think we've got that job done. Here's 75 million acres of wilderness in the 50 States that is all protected. We have got guards that keep the burglars from coming in to the cliff dwellings. We have got laws against loggers cutting down the trees in the national parks.

But here the national parks and the wilderness areas are going to be in danger from an insidious poison that comes over the fence all night long and during the daytime as well. I think it is important that we get the data base that we need. It is obvious to me that we don't know where we are going but we know enough that we ought to be alarmed. We ought to be making some judgments. We ought to be on the conservative side on those judgments because we lose some very precious things if we don't do it.

I would have some advice for the Grand Canyon folks and maybe some of the others in the Southwest. For years we had arguments in Arizona about what the smelters were doing, the fact that Phoenix has fog. I used to fly in my little airplane, and in the approach to Phoenix airport there was no problem. You got a layer of crud at 4,000 feet now most of the time when you go in there. And everybody blames everybody else. The copper companies say that it is dust on the streets and the farmers are kicking up dust when they plow, and so on. The other folks blame the mining companies.

We missed a couple of God-given opportunities. They had a strike. I don't like strikes. I feel for the employees. But we had a couple of strikes over the last few years. We had a chance then to compare measurements in the air and measurements on the ground, to test the evidence that suggests that the smelters in southeastern Arizona have a lot to do with pollution in Wyoming and Colorado. We had a chance to really get some important data. I hope—I am not trying to provoke any strikes—but there may be some smelters closing as some of the mines have closed for economic reasons. We ought to be ready with some kind of a plan. I would hope the Park Service would have some kind of a plan to take advantage of these periods when we may have things closed down.

Mr. **MALM**. I can respond to the work that has been done, especially at Grand Canyon in terms of identifying where the sulfates come from. The sulfates at Grand Canyon are the single most predominant air pollutant at this time. The work on long-range transport is summarized on this graph over here. Do you want me to bring that forward?

Mr. **VENTO**. I think that would be useful to do, because there have been all sorts of backhand efforts here to try and suggest where this came from, not the least of which was Mexico, I guess. Let's look at what the science of it is.

Mr. MALM. From the standpoint of Grand Canyon, what appears to be the single largest contributor to pollution at Grand Canyon comes from air masses that come out of the San Joaquin Valley, down in front of the Sierras, through the L.A. area, Los Angeles contributing, and then flowing into Grand Canyon. We refer to that as the southern California plume. The southern California plume flows up in this direction. It impacts Grand Canyon, Bryce, Canyonlands. We have tracked it back. Even to the Rocky Mountain National Park we see the impact of the L.A. plume as it moves out across the Western United States.

That is the single biggest contributor to pollution at the Grand Canyon.

The second biggest contributor to pollution at the Grand Canyon comes out of southern Arizona. That is, of course, the copper industry that has an effect on that. You see pollution coming from southern Arizona moving up into Grand Canyon, mostly in a circular fashion like this.

Other areas at Grand Canyon, as I said, we have done a substantial amount of work. We have identified some impact from the El Paso area. We have identified impact from the Navajo powerplant, from the Four Corners powerplant, from the smelter up in Salt Lake City, possibly from the Hayden and Graig powerplants up in Colorado. So, we have identified some pollutant impact in Grand Canyon from all these sources.

That is the only area that we have done that sort of intensive analysis on, to the point where we can identify these various sources that actually impact the area.

The CHAIRMAN. That is the kind of thing we are going to need a lot of.

Do the scientists have anything like they have in the hospitals where they can tag radioactive elements, leave out a molecule or something so that you can say this particular pollution came from so and so? Can you run a test of that kind? Can you identify at Grand Canyon how much of the smog came from southern Arizona and how much from Los Angeles?

Mr. MALM. Source attribution, that is, determining the relative impact of the various sources on a receptor site such as Grand Canyon, is something that is intensively being investigated right now. There are all kinds of suggestions as the best way to do it. The technology really doesn't exist at this point to with a high degree of accuracy say what percentage of the time this source is impacting a receptor site or that source. We can put air bars on it. We can say that 70 to 80 percent of the time it may be an L.A. impact for Grand Canyon. And so we can put big air bars on it. But to tie it down to highly precise numbers, that is something that is under investigation at this point.

The CHAIRMAN. It is pretty clear to me that we are going to have to get a data base if we are going to get the American people to accept some of the things they are going to have to accept, if this situation is as bad as it appears to be. And I think we need a scientific data base of the best sort we can get. I am glad to see that some efforts are being made in that direction.

Mr. MALM. I would concur there. I think that the data base at this point is just really inadequate. Although, as I made the point earlier, we are doing some monitoring out there. The monitoring we are doing, we are doing, I think, quite well. The data base is so limited and there are so many things that we are not looking at that, when the question comes up whether it is a nitrate or a sulfate or whether it is heavy elements or whether it is heavy metals or whether the pH is being changed because of that source or this source, the data just isn't there to determine exactly what the relative contribution is.

The CHAIRMAN. Thank you, Mr. Chairman.

Mr. VENTO. Thank you, Mr. Chairman.

Mr. Lagomarsino was conferring here, and he said no thank you would be necessary for their contribution to Arizona. There's no invitation that is extended.

The CHAIRMAN. We'll send him on nuclear waste, that which doesn't go to Utah. [Laughter.]

Mr. VENTO. Of course, I don't think anyone would disagree with the basic need to improve our science in these areas. I guess the question is whether or not we are doing the job that we have to do and that can be done with regard to avoid the most critical types of an at-risk type of environment today.

The gentleman from Utah, Mr. Hansen.

Mr. HANSEN. Thank you, Mr. Chairman.

The gentleman from Mesa Verde, Mr. Heyder, your park basically is one of ruins, isn't it? Don't you folks go in and do some excavation? Don't you protect the ruins that we have seen—not ruins. Let me say ancient dwellings of people of years back.

Mr. HEYDER. Well, sir, there are about 4,000 ruins in the park, about 700 of those which we would classify as cliff dwellings. There are about 19 of the ruins that are really large, that you would say a large ruin, such as a spruce tree, a cliff palace, balcony house, long house.

Mr. HANSEN. But it doesn't fall into the category, in my humble opinion, of what the Congressional Research Service, the Library of Congress has done, as we have been reading their air quality in the national park, which alludes to trees and vegetation, primitive plants, ozone injury, things such as that. We are looking at places where an ancient or some type of individual lived at one time, isn't that true?

Mr. HEYDER. Well, you are looking at two things, sir. I think that the forest was there when the aborigines were there and the wildlife. So, you really have a continuum of time. The people abandoned Mesa Verde 700 years ago, and the forest came back.

Mr. HANSEN. I have no argument with that. I am just saying that the attraction, the magnet that makes us gravitate to that particular area is not for the wildlife or the trees. We go there to see the things that occurred. I have no problem with the theory of trying to protect the ruins. But when you ask the question, what is posing the biggest problem to your park, and what would cause it? Would pollutants be the biggest problem to your part? I have a hard time seeing it.

Mr. HEYDER. I think they would be, sir. I think that acid rain, we really don't know the full effect of that.

Mr. **Hansen**. But let's say this housing unit that was put there 700 years or 7,000 years ago, what would acid rain do to that compared to a tree or something like that?

Mr. **Heyder**. Acid rain could cause a reduction of the housing, one of the ruins. You have to realize that the—well, we had an interesting experiment, if I could explain for a second. About 5 years ago we took four or five samples of ancient mortar and four or five small samples of rock. One of our geologists at our Denver service center did some experiments with them, along with people from USGS.

They made slices of them. They were able to grind it down. They were able to tell the different chemicals that went into the rock. And then that night, overnight they placed that in an acid bath. It was a 6-percent acidic acid bath. The rock lost 9 percent of its weight. So, I think that makes a strong case for acid rain to do damage, sir.

Mr. **Hansen**. I appreciate that. That is very informative. It would probably give us a better reason than I thought was there before.

Mr. Marks, I am glad to welcome Richard Marks here. I had an interesting time with him in the Phantom Ranch when I was running the Colorado River. I appreciate the great work you did there and do now.

You said the canyon is 217 miles long. Is that right?

Mr. **Marks**. Yes.

Mr. **Hansen**. What would be the elevation from the north rim down to the lowest part?

Mr. **Marks**. The north rim is, in round figures, 8,000 feet. The Phantom Ranch is about 3,300 feet. So, about 1 mile depth from the rim down.

Mr. **Hansen**. So you could look at the whole scope from almost tropical up to the north rim and see quite a difference in vegetation?

Mr. **Marks**. Vegetation mass, and the climate at the Phantom Ranch is very similar to what is in Tucson, AZ. The vegetation and climate on the north rim is similar to what would be found around Boise, ID. In 1 mile you can go about 800 horizontal miles.

Mr. **Hansen**. You and Mr. Malm pointed out that there are monitoring devices in the Grand Canyon, is that right?

Mr. **Marks**. There are monitoring devices both on the south rim and on the plateau down in the canyon itself.

Mr. **Hansen**. So, you cover all of this in your elevation and your great length with those monitoring devices?

Mr. **Marks**. We cover the elevation, but we do not monitor outside the general area of the south rim village.

Mr. **Hansen**. Of course, it is obvious what I am leading to. Where was the most pollution found? Would it be high, low?

Mr. **Marks**. Excuse me?

Mr. **Hansen**. Where was the most pollution? Would it be at the high elevations, the low elevations, up in the east end or the west end?

Mr. **Marks**. It would be probably more in the eastern end. The longest monitoring we have done, obviously, is up on the south rim. So, the base material data is there. That which we have done down in the canyon has only been there for 1 year, so we don't have much information.

Mr. **Hansen**. So, you would say the east and the south——

Mr. **Marks**. South and east.

Mr. **Hansen**. So, the southeast puts you closest to the Navajo, as Mr. Malm alluded to a moment ago, that puts you closest to the Navajo powerplant. Is that right?

Mr. **Marks**. Powerplant. Basically, the monitoring we would look toward would be from desert view on the east and a mile or so past the south rim village.

Mr. **Hansen**. Would you say the closest pollutant, aside from the interesting map that was brought out, would be the Navajo powerplant?

Mr. **Marks**. I would——

Mr. **Hansen**. Or source of pollutant?

Mr. **Marks**. I would suggest not on the basis of the predominant weather and the predominant wind factor blows away from the plant——

Mr. **Hansen**. Yes, the prevailing winds go——

Mr. **Marks**. The prevailing winds go west to east——

Mr. **Hansen** [continuing]. From west to east——

Mr. **Marks** [continuing]. And from south to north——

Mr. **Hansen**. Yes.

Mr. **Marks**. What you might find from your standpoint is the interest from Bryce Canyon and Zion, where it's the same Navajo plant that affects that at a great degree than it does the Grand Canyon.

Mr. **Malm**. Let me comment on that, if I may.

Mr. **Hansen**. Surely.

Mr. **Malm**. There is just recently a study that has been established to try to understand those pollutant gradients that you were potentially referring to. There is a monitor that has been installed down at Lake Mead, which is the bottom end of the Grand Canyon. We also have monitors at the south rim of Grand Canyon as well as monitors up in Lake Powell itself, which is really the eastern end of Grand Canyon.

The meteorological conditions are, of course, very important to determining how pollutants are distributed. During the summertime, you tend to see regional impacts that are quite uniform. They tend to be regional in extent, probably have their source from, the major impact is from great distances. During the winter months, where you have stagnant air masses built up, where local pollution does not disperse, then you can see impacts from local sources. That is when the Grand Canyon is the cleanest, because it doesn't have any strong local sources.

You have the Mojave generating station down at one end. You have the Navajo generating station up at the other end. You may see major impacts at both ends in some of the parks at both ends like Glenn Canyon. But the Grand Canyon itself has a minimal impact under those kinds of conditions.

Mr. **Hansen**. Would you repeat that statement again? You say Grand Canyon has a minimal impact. Is that correct?

Mr. **Malm**. Under stagnant air mass conditions where you don't have good dispersion. Where you have good dispersion is when the

Grand Canyon becomes impacted the most, during the summer months.

Mr. **Hansen.** Mr. Malm, these monitoring devices that the superintendent alluded to, are you the gentleman assigned to check those out and take the readings? Who is assigned to that? Who is in charge of the monitoring devices?

Mr. **Malm.** I am in charge of the monitoring devices.

Mr. **Hansen.** How do they work?

Mr. **Malm.** The monitoring devices that we have out there, as I said before, do a good job of measuring certain kinds of things. We do a good job of measuring sulfates, fine mass and coarse mass, we don't even attempt to use those devices to get at the organic material or the nitrates or some of the different kinds of chemical components that exist in the atmosphere.

Mr. **Hansen.** So what do they measure, then, and how do they do it?

Mr. **Malm.** The particulate monitors collect the pollution, the particles on a filter. Those filters are subjected to a cyclotron beam. From that, we can determine what the elements are on that filter. So, we do an elemental analysis of sodium, magnesium, potassium, sulfur, all those sorts of things.

From that information, we can determine how much sulfate is in the atmosphere, but we really can't tell—and we can tell how much crustal material is, that is, wind-blown dust and that sort of thing. But we can't say anything, as I said, about the other kinds of pollution that are there.

Mr. **Hansen.** Do they have a history of being accurate?

Mr. **Malm.** Oh, yes.

Mr. **Hansen.** They have been around a long time?

Mr. **Malm.** They haven't been around so long, but we have gone through extensive cross-comparisons with 10 other samples that are used in other monitoring programs.

Mr. **Hansen.** So, you measure one type against another?

Mr. **Malm.** One against another. We use laboratory blanks, standards. And the quality of the mass and the element concentrations in the fine mode is excellent.

Mr. **Hansen.** Superintendent Marks, what would you say the actual damage is to the Grand Canyon that you have observed as superintendent there?

Mr. **Marks.** I have been at Grand Canyon 5 years. I think the damage that we have seen is based on those people who come to the park and have identified most recently in a major survey in 1983 the air quality. Eighty-some percent of the folks said that air quality was the most important factor. When it was bad air, it affected them greater than perhaps in other places. They want to arrive at Grand Canyon, see the park, see it as clean as possible in their eyes, and then go somewhere else.

Mr. **Hansen.** Any fish kill in the Colorado River?

Mr. **Marks.** No; that was not mentioned under this air quality program. But in our cooperation with the Bureau of Reclamation, as they are studying the effects of the Glenn Canyon dam, we have asked them to look at that. The State of Arizona game and fish is in fact looking at samples to determine if in fact there is any indication of that.

Mr. **Hansen**. I see. Thank you.

I would just like to add I think you have one of the best of all. I appreciate the great work you do on that. I would hate to see that one polluted.

Mr. **Vento**. I thank the gentleman.

Mr. Marks, obviously there is never enough time in this questioning. Is there any dollar figure that has been attached to the amount of tourism that has been lost as a result of that 1983 survey, or where it indicates that people are disappointed in the Grand Canyon because of the air pollution problems and the lack of visibility?

Mr. **Marks**. No; I don't think they have come to the conclusion that they would not come back to Grand Canyon. What they have said, though, is that the air quality is better at the source where they have come from than it is in Grand Canyon. I am not sure how you tie that together, but that was one of the conclusions.

Arizona has, as its second principal revenue, recreation and tourism. I think as this continues, I think the important factor is, where do we go from here, what is to be done about it? I think as it begins to deteriorate or continues to deteriorate, whichever, we will begin to see folks going elsewhere.

Mr. **Vento**. You have no reports of any plant problems there, lichen problems?

Mr. **Marks**. No.

Mr. **Vento**. How about the Rocky Mountain park?

Mr. **Marks**. We do not, no.

Mr. **Vento**. The Rocky Mountain, lichen or plant damage there?

Mr. **Thompson**. There has been an indication of some ozone damage to Ponderosa pine. We are going to have a study started this summer which will begin to measure that.

Mr. **Vento**. Mr. Malm, I just want to emphasize this particular point. You pointed out that the Grand Canyon visual pollution is worse when there is a period of dispersion of air pollutants as opposed to when there is a stagnation. Why is that?

Mr. **Malm**. Generally, in all the national parks that we monitor, the visibility, the air pollutant concentrations tend to be highest during the summer months because that is when the pollutants in the urban areas in the distant sources get mixed up in the upper atmosphere and are transported into the national parks.

Mr. **Vento**. The sulfites are the big problem in the Grand Canyon, are they not?

Mr. **Malm**. They are the single biggest air pollutant in every national park that we are monitoring.

Mr. **Vento**. They are responsible for what percentage of the visual pollution in the Grand Canyon?

Mr. **Malm**. Our work indicates that in Grand Canyon that the sulfates are responsible for—this is not natural air, now; this is the particulate matter that is in the atmosphere itself. Sulfates are responsible for 60 percent of the visibility reduction. There is an ongoing debate within the scientific community as to what is the best way to do that calculation. That number, to be fair, could be dropped probably to 40. So, the air that we are talking about on the relative contribution of sulfates to visibility reduction is maybe on the order of 20 percent. So, it would be 40 percent to 60 percent.

Mr. Vento. In other words, they make a bigger contribution than their presence would indicate.

Mr. Malm. That is exactly right.

Mr. Vento. OK. Well, the panel has done an excellent job. We appreciate your input. I think you are helping us understand this. You are dismissed.

The committee will be in recess for 10 minutes.

AFTER RECESS

Mr. Vento. The subcommittee will resume its sitting.

I would like to call the next panel. You have notified my staff concerning the fact that you have travel problems. I hope we can get to everyone today. If you do have any special problems, we hope to conclude this as well. It might not be as early as we initially anticipated, but presumably we can keep moving along.

I would like to call the fourth panel: Mr. Ronald Wrye; Robert Jacobsen; and Robert Davidson, all, of course, Superintendents, Acadia, Shenandoah, and Gettysburg.

Gentlemen, you are at the table.

PANEL CONSISTING OF RONALD N. WRYE, SUPERINTENDENT, ACADIA NATIONAL PARK; ROBERT R. JACOBSEN, SUPERINTENDENT, SHENANDOAH NATIONAL PARK; AND ROBERT DAVIDSON, SUPERINTENDENT, GETTYSBURG NATIONAL MILITARY PARK

Mr. Vento. We have asked a series of questions for obvious reasons, but let me put them again to you. I don't know if I can identify you. Mr. Wrye is seated in the center.

Let me ask the same series of questions that were raised initially, Mr. Jacobsen, with regards to generally your monitoring programs that deal with cultural, aquatic, visual, and so forth, then your major problem as you perceive it in your park, and maybe adding in whatever studies or science that you feel is of particular interest in this matter. Mr. Jacobsen.

Mr. Jacobsen. Mr. Chairman, we have been in the Air Protection Program at Shenandoah since about 1976, which was 1 year before the Clean Air Act amendments were passed and almost 2 years before the air quality division was developed in the National Park Service.

As far as monitoring is concerned, we currently have three monitoring stations in the park: the northern end, the middle, and in the southern end. The park is about 80 miles in length. These are at different altitudes as well. We are collecting data on a daily basis, hourly basis, on ozone and sulfur dioxide.

This summer we are intending to also install three more monitoring stations at the same latitude in the park but at different elevations, immediately stepping down toward the west so that we can determine whether there is an altitudinal gradient particularly in ozone. We have found through our effects research that there appears to be more damage at the higher altitudes.

We also have been monitoring for visibility for about the past 5 years, using a teleradiometer and a camera. We have been a member of the National Acid Deposition Program for at least 2 years and have been collecting both wet and dry deposition samples. We operate a high volume particulate sampler at park headquarters.

We have been involved in a number of monitoring programs conducted by other people such as the FORAST Program, which is being run out of Oak Ridge, TN. We are talking right now with the University of Virginia about the possibility of establishing acid fog monitoring devices at at least three locations within the park. In the years past, we have put instruments aboard an airplane flown by VPI and SU in which we probed air masses with an airplane, both laterally and altitudinally, and have tried to fly back air masses in plumes back into their area of origin so that we could begin to gather data as this whole process is evolved.

Mr. Vento. It sounds like that you have one of the most aggressive monitoring programs at least in terms of duration for 9 years, and in terms of trying to try some innovative means, the plume issue, the issue of trying to monitor fog with the State of Virginia. It is very encouraging to hear that.

I guess what is probably most interesting, though, is what is the case. What is this air pollution doing to Shenandoah National Park?

Mr. Jacobsen. OK, well, that gets us into the effects research activity. As far as ozone is concerned, we have found that there is a very definite decline in the white pines within the park. We have known this for a number of years. This is caused directly by ozone and with the episodes of high ozone being immediately traced back to tip burn.

We have in times past actually grown forest plants in ambient air and in open top chambers, blowing through ambient air and then filtered air to remove ozone, to make sure that that was the pollutant that was causing distress. Indeed, we have proven that, by removing ozone right there on site or by injecting it, which is something that we did last year, that we can have a dramatic effect upon the growth, the vigor, and biomass of the plants.

As far as sulfur dioxide is concerned, one of your star witnesses yesterday was Jim Galloway, from the University of Virginia, who talked about the problems on White Oak Run in the southern part of the park. He was one of the first to come to the park in about 1976, telling us of the low acid precipitation. And I don't think I need to talk in any further extent about the sulfur absorption which is going into the soils, the changing of the soils, and their ability to sustain plant growth, which is primarily work that he was doing.

We have also studied our lichens to see if they are accumulating sulfur and have found that there is an elevated level of sulfur in our lichens, although, so far as we know, there is no decline in numbers; it is just that there is more sulfur residual than would be found in other places.

I should go back on ozone. I failed to mention that we have looked at six other forest plant species in 1982 and 1984 and found that the leaf spotting is very prevalent on milkweed, on grape, on yellow poplar, on clematis, and a couple of other forest plants. So, we know that there are definite effects.

As far as visibility is concerned, we receive the air that is flowed over most of the rest of the country. Fifty percent of the time in the spring and summer we are unable to see the Allegheny front range, which is less than 35 miles away. In order for visitors standing on the elevated Skyline Drive to get a geographical context of how the park fits into the rest of the geography, they cannot see it. Fifty percent of the time they can barely see the Massanutten Range, which is the first mountain range and which is only 10 miles away. When you can't see 10 miles at all, that means that anything that lies between you and 10 miles away is very visibly impaired.

A person 10 percent of the time cannot see Massanutten at all. You cannot see the bends of the Shenandoah River down below. It is very difficult to make out the panoply of the forests, the fields, the towns, and the roads which this elevated viewing platform, the Skyline Drive, offers.

Mr. VENTO. Would you say, Mr. Jacobsen, that that has substantially reduced the benefits for which the resource was established?

Mr. JACOBSEN. Without any question. One of the purposes of Shenandoah, one major purpose, of course, being to try to preserve an area in the natural, or at least allow it to recycle or revert to its natural condition. But in the legislative history, it talks about the opportunity for viewing the Shenandoah Valley on the west and the Piedmont on the east. I think that for many people here on the eastern seaboard, this is one of the few places where they have an elevated highway 105 miles long which lies as much as 3,000 feet above the valley floor on either side. They come for that view. When they are prevented by other than natural reasons from looking down and seeing the world in miniature, I think they very definitely feel cheated and disappointed. And they do complain to us.

Mr. VENTO. Do you think that to some extent that might impact the fact that—have the visitor numbers been holding up in your resource or not?

Mr. JACOBSEN. We are holding fairly even at 2 million visitors a year, with as many as 35,000 in a single day.

We find that the light extinction which we are suffering is primarily from sulfates. We had a study run by General Motors research laboratory. It was confirmed by EPA that 78 to 86 percent of the light extinction during the period in which they measured was man-caused, being primarily sulfates, a regional problem, the air masses moving in from other parts of the country.

Mr. VENTO. Very good. We have a vote coming up momentarily, but maybe we can get to Mr. Wrye, and you can explain your monitoring program. Obviously, we won't have as much time before the vote, but I intend to come back.

Mr. WRYE. First, I would like to express my pleasure in learning of your upcoming trip to Acadia this summer. I look forward to being of whatever help I can be to you in making that meaningful.

Mr. VENTO. I appreciate that. We are looking forward to it. We think it will be helpful in terms of dealing with the issue of a legislative boundary.

Mr. WRYE. We have some of the same monitoring programs in place that you have heard other park superintendents already mention. We have visibility monitoring stations similar to other parks. We have an ozone monitoring program as well. You have heard others mention the ozone damage and impacts to the eastern white pine in Acadia. Certainly some of the pictures that we furnished the committee are from the Acadia white pines.

We have as part of the visibility program photographs being taken on a regular basis from a dominant vista, from the top of Cadillac summit to Blue Hill main, which is approximately 25 miles to the southwest.

We also have an acid rain monitoring station in place at Acadia. We have been monitoring acid precipitation. I think you heard from Dr. Anderson yesterday and heard testimony. She indicated some acidification of streams at Acadia, particularly the first order small brooks at higher elevations and one rather major pond called Sergeant Pond.

Acadia has very limited buffering capacity. In its soils it is made up largely of granite, bedrock, particularly at the higher elevations, vegetation and topsoil is really quite rare. So, the acid precipitation falls in the park and it really does not leach or modify. It remains acidified.

We have a cooperation agreement negotiated with the State of Maine for the maintenance and operation of some of our equipment. I am not sure how many parks are working with a State quite that closely, but we have worked very, very closely with the State. They use our data, and we use theirs at other stations and monitoring locations within the State of Maine. So, we exchange readily information on acid rain and ozone monitoring.

Mr. VENTO. Have you noticed, Mr. Wrye, any damage now from this? In other words, has there been any type of a concern with regard to the acidification of any of the lakes in Acadia or streams?

Mr. WRYE. We have not noticed any impacts other than the ones I mentioned. The fishery evidently has not been impacted yet. The larger ponds and brooks have not been impacted, at least to our knowledge they have not.

Mr. VENTO. What do you look at as being the No. 1 threat to that resource today?

Mr. WRYE. I think, without question, based on what we know and what we have learned as of last summer, the ozone threat seems to be the greatest threat to the vegetation.

Mr. VENTO. So, it is air pollution.

Mr. WRYE. Air pollution.

Mr. VENTO. Mr. Jacobsen, you would share that view with regard to Shenandoah, that air pollution represents the——

Mr. JACOBSEN. I would say immediately, instantly, visibility is our problem. But in the long run we are going to—ozone is affecting us right now—but in the long run I think acid precipitation is the one that is going to change the soil and its ability to support plant life. All three of them are important.

Mr. VENTO. The air pollution then in general you think represents the problem. The ozone is the most specific.

What is the size of Acadia?

Mr. WRYE. It is 35,000 acres.

Mr. VENTO. That is small by our standards in Minnesota.

Those bells that have been ringing indicate that my presence is required on the floor to vote on some important matter. We will recess for about 10 minutes. We will resume with the same panel, Mr. Davidson, and hope you will understand.

We stand in recess for 10 minutes.

AFTER RECESS

Mr. VENTO. The committee will resume its sitting.

I think we have got a period now where we can continue without being interrupted by bells. At least that is my hope.

Mr. Davidson, you had not had an opportunity yet to explain the monitoring program in the Gettysburg National Military Park and what you see as the problems or damage that is occurring there vis-a-vis air pollution. Mr. Davidson.

Mr. DAVIDSON. Thank you, Mr. Chairman.

Our monitoring efforts at this time are limited to one acid deposition monitoring station, which is part of the Pennsylvania network, the Commonwealth of Pennsylvania network, and not part of the national system right now. We are responsible for taking the samples. Then they are shipped to Penn State University where the analysis is done. Then they put together the data. We receive copies of that. That is the extent of our monitoring at this time.

Of course, at Gettysburg we are primarily concerned with the effects of air pollution acid rain on our monuments. Gettysburg National Military Park probably has one of the best collections of bronze and granite monuments in one place in the United States. There are 1,300 in all. Many of them were sculpted by world famous sculptors at the turn of the century. They have been termed a national treasure by some art experts. It is a high quality collection of monuments that we have there.

Our main concern is with the accelerated rates of deterioration. This can be seen in various colored corrosions which appear on our bronze monuments, very disfiguring. They certainly make it difficult to appreciate the artistic value of these works. In addition to the streaking and the disfiguring corrosion, we also have some really dramatic examples of the loss of historic fabric. On some of our softer stone such as limestone and sandstone, the inscriptions actually have been obliterated to the point where they can't be read any longer. Of course, these are worst case examples.

We have, of course, a large number of granite monuments in the park. They don't seem to be as dramatically affected by the acidity as is the limestone and the marble and bronze.

Mr. VENTO. This damage, I am looking at some of these, I guess they must be sandstone. That is what these monuments look like to me. Is that right?

Mr. DAVIDSON. I think the worst case examples there are probably limestone. It is very susceptible to damage.

Mr. VENTO. Of course, limestone I know would be, but this one does look like sandstone.

Mr. DAVIDSON. There are some sandstone monuments, yes.

Mr. VENTO. Maybe I haven't looked at the worst ones yet.

Oh, yes, I see what you are referring to here in terms of some of the scalling that has gone on.

These are going to be very helpful, I think, in pointing out the absolute damage that has occurred with regard to air pollution and, I guess, to some extent acid rain, which is what you are suggesting is the primary factor that has caused that. Is that correct?

Mr. DAVIDSON. I think the linkage between the corrosion and the destruction of the stone has been pretty well established. I guess the only thing we really don't know is how fast we are losing it.

A little change of pace, though, at Gettysburg we are doing something in a small way to mitigate the damage. Starting in 1978 we started a program of washing and waxing the bronze statues in the greatest need. Although this isn't a final solution to the problem, what it does is it improves the appearance of the bronze, for one. No. 2, the waxing process helps keep the acid rain away from the metal. That is one thing.

The other thing that we have started this year is a park crew is beginning to wash and rinse off the stone monuments. Again, although it doesn't do anything permanent to protect the stone, it does remove chemicals on the surface. It improves their appearance significantly.

Mr. VENTO. That is interesting. I am sure that that is helpful in the short run. But in the long run that sort of effort will not really resolve the issue.

I noticed you mentioned the State of Pennsylvania. Does Pennsylvania have a separate program going on with regard to air monitoring?

Mr. DAVIDSON. They have a monitoring network throughout the State of Pennsylvania. Many of the stations are in State parks. We had an opportunity to participate in the program. We were responsible for purchasing the equipment, I think, for something like $4,000. That got us into a program. It was a very inexpensive way for us to participate and to begin to develop some baseline information.

Mr. VENTO. That is the only baseline data you have right now, that Pennsylvania program. Is that right, Mr. Davidson?

Mr. DAVIDSON. At the park, yes.

Mr. VENTO. That is interesting. That is basically a wet deposition type of monitoring.

Mr. Malm, I guess, had to leave. I don't see him anymore. I think he was referring to the Grand Canyon. And that is only a wet deposition site as well.

I think all of you have responded very well in this panel. I have one question, Molly, while you are still here. Maybe I could just ask you while these gentlemen are at the table, the legal authority under which the Department of the Interior operates with regard to the Clean Air Act and with regard to air pollution in general. The Clean Air Act obviously under a Federal land authority responsibility in terms of responding, in terms of class I or class II, where indeed you are aware of the problem both to the EPA and to the States. But isn't there further legal authority that would exist in terms of protection of the resources in the basic Organic Act?

You knew that was going to come up, I see, by that.

Ms. ROSS. Mr. Chairman, the Organic Act protection, the responsibility of the Secretary of the Interior through the National Park Service is in very strong terms to conserve unimpaired the resources including such things as wildlife, natural objects, scenery in units of the National Park System. The fact that there is a

Clean Air Act throws some legal question on to how effectively we will be able to use our existing authorities such as the Organic Act to protect certainly class I parks that do get some degree of protection under the Clean Air Act as well as the other units of the National Park System from the adverse impacts of air pollution.

I think that we hope that that authority is there. But because of some Supreme Court cases in the area of the Clean Water Act where the Supreme Court found that the existence of a comprehensive pollution statute such as the Clean Water Act in that instance undercut the availability of traditional remedies such as nuisance and trespass, which is the way that the Department of the Interior has typically enforced the Organic Act.

I say there is a degree of legal question there. Until the courts resolve it, I don't know that we have the answer.

Mr. Vento. I think that is correct, that there has not been a legal resolution. I don't know if the Solicitor's Office through you—and I guess you would be the principal person that is working in terms of the ambient air standards and the law dealing with clean air. Am I accurate in that assumption?

Ms. Ross. I have to clarify one part of that. I was in the Solicitor's Office for 6 years. A year ago I left to become part of the air quality program of the National Park Service.

Mr. Vento. But the Solicitor's Office has rendered no opinions on this, have they, out of the Department of the Interior? Have you got opinions that have been provided? If they are, if you would, if I could ask that they be made available to the subcommittee with respect to this.

[Editor's note.—Response to Chairman Vento's request may be found in app. II, in a memorandum from the Associate Solicotor to Director, National Park Service, dated September 20, 1985.]

[Congressional Research Service review of Solicitor's report entitled "Protection of National Park System Units From the Adverse Effects of Air Pollution" may be found in app. II under additional statements and correspondence were also received. See table of contents for page number.]

Mr. Vento. This is not just a moot point. I expect if I went through the Clean Air Act—and I don't know this—that there would be some provision in the Clean Air Act that would say something like it does not affect other laws; it is not intended to, but that it is an extension of protection under class I, not a limitation upon protection.

I think that, if I went through it, I would find that language, that it is, notwithstanding any other law, is not the provision that we are dealing with there.

Also, in the 1978 Amendments to the Organic Act, the 1978 amendments, establishes a public trust doctrine for parks. So, I think there are any number of legal cases. I think that what would be helpful to me is for you, if it were possible, Molly, or the appropriate person in the Solicitor's Office, if you want me to make that request—and I will consider it if it is improper for you—to review those and to try and suggest to us what the impact and responsibility is with regard to the responsibilities of the Department of the Interior under air pollution problems that you are facing: Responding to the Clean Air Act, responding to the Organic Act, and the most recent amendments to it.

Beyond that, I guess there is a question of whether the Department of the Interior judgment call it is, as to whether or not they ought to take action. But I think we are trying to clarify in this instance what you believe or the Solicitor's Office, if it is more appropriate, believes is the authority that they have and the responsibility to deal with air pollution in these instances.

Is this an appropriate question for you to work on?

Ms. ROSS. I think I can work through the Department on that, and the legal opinion would probably come——

Mr. VENTO. I think others are here from the Department. Mr. Smith I saw just a moment ago, and others. If there is further need for clarification of the question, I think that I would be happy to provide it. Mr. Smith.

Mr. SMITH. Mr. Chairman, we will provide that through the Department as part of the record. It will be provided. We don't need a restatement from you. But it will come from the Solicitor's Office through the Department back to the committee.

Mr. VENTO. Thank you very much. I appreciate it.

[EDITOR'S NOTE.—The information referred to above has previously been admitted to the hearing and may be found on page 371.]

Mr. VENTO. I want to thank this panel. Thank you very much for your testimony. I think it has been helpful.

The next panel is the scientific staff of the Park Service who have been so helpful and Mr. James Bennett, who earlier appeared. Dr. Ray Hermann is Director, Water Resources Field Support Laboratory. Dr. O. Clifton Taylor is professor of Plant Sciences, University of California, Riverside.

Gentlemen, please present yourself to the witness table. We are going to try and take Mr. Taylor first so that we can excuse him, as he has a flight to catch.

Mr. Taylor, why don't you proceed?

PANEL CONSISTING OF DR. RAY HERMANN, DIRECTOR, WATER RESOURCES FIELD SUPPORT LABORATORY; DR. JAMES BENNETT, ECOLOGIST, AIR QUALITY DIVISION; AND DR. O. CLIFTON TAYLOR, PROFESSOR OF PLANT SCIENCES, UNIVERSITY OF CALIFORNIA

Mr. TAYLOR. Mr. Chairman, what I wanted to speak about most today is the research that I have been most interested in, and that is looking at economic loss to agricultural crops due to air pollutants in California. However, I would like to mention some work that I have done in the national forests and I am doing now for the Park Service.

Back to the agricultural losses, we started this work in 1962 and found in the south coast air basin near Los Angeles that the crop loss for lemons and naval oranges was in the neighborhood of about 35 percent per year. It would vary depending upon climatic conditions from one year to another, but that was about it. Near the Ontario airport in the south coast air basin, the ozone and the natural smog was responsible for about 50 percent reduction in the grape crop in that area. Naturally, we recognize the fact that we have more ozone in that area than most any other place in the United States.

Mr. VENTO. You say a 50-percent reduction in the grape crop?

Mr. TAYLOR. Fifty percent loss in crop, yes.

Mr. VENTO. From ozone?

Mr. TAYLOR. From ozone.

Mr. VENTO. When was that episode?

Mr. TAYLOR. That was the season of 1978, I believe it was, 1978 and 1979.

Mr. VENTO. Very good, please proceed.

Mr. TAYLOR. Then we extended the project on agricultural losses in the national crop loss assessment program, which is an EPA supported project that started in 1982. There are several laboratories cooperating in that. The University of California, Riverside, is one; Argonne National Laboratory; Lawrence Livermore; USDA at North Carolina State University; Boyce Thompson; USDA Beltsville; Oregon State University; and EPA at Corvallis. All are involved in this.

The goal is to gather information on dose response. In other words, we are treating agricultural crops, selected crops with ozone, six levels of ozone throughout the season and then measuring the effect on crops. We selected the 10 top economic crops of the Nation: Soybeans, wheat, corn, and such and that, but not getting into the woody perennials.

In California the first crop that we worked with was cotton, since it is a leading income of the State agricultural crops. One year it was 20 percent loss in crop. The second year it was 15 percent. That is from ambient ozone. There was a difference in the total dosage those years. The second year, there was less ozone in the air.

We also looked at winter barley, put that in between the two cotton crops. Both years, there was not a significant effect of ambient ozone on the barley. We think that is primarily because during the winter season we don't have as much as smog as we do the rest of the year. But if we added—and we added three different levels—one third of ambient, two thirds of ambient, and doubled ambient, we then got crop loss from that. But that is spiking the ambient—oh, I should say that these last, the cotton and the barley, were run at Bakersfield, at the USDA cotton research station at Shafter, which is 18 miles northwest of Bakersfield in the Central Valley.

We also ran one season with head lettuce, the empire variety, which is the leading shipping lettuce out of California. And we routinely see visible symptoms on leaves of this variety of lettuce. But in this study we got no effect of ambient levels, but the additions of one third caused a very significant reduction in both the weight of the crop and the number of marketable heads.

We also started last year with an alfalfa variety, the WL-514, which is a prominent new variety in the San Joaquin Valley. The first season of that last year, the ambient ozone did not cause significant crop loss. It was 5 to 7 percent, but statistically it was not significant. But the added increments of one third, two thirds, and doubling did cause significant loss. We are running the same crop again this year. Then that will probably terminate the agricultural crop studies for us for a while, at least out there.

I would like to mention two that we got involved with, the effects of ozone on forest vegetation back about 1958 or 1959, and ran fumigation experiments with seedlings of pine trees. Then this led to a project started in 1973, I believe it was, with the Environmental Protection Agency looking at the total ecosystem in the San Bernardino National Forest. This is at an elevation averaging about 6,000 feet and about 70 to 100 miles east of Los Angeles, to give you a location of the forest. This was a cooperative program involving entomologists, pathologists, soil scientists, wildlife people from Berkeley campus, plant people from the Riverside campus, the U.S. Forest Service.

In that, some of the major things that we discovered were the effects of the ozone on production of wood, similar to the increase in tree rings here by looking at that and calculating the effect on wood production. The ozone injury—and we had a lot of it on the leaves—increased pine bark beetle damage, increased root rot from organism, and very significantly increased the fire hazard because of the dead limbs and twigs and heavy foliage deposit on the floor of the forest. Also, with the deposits, the leaves discouraged new seedlings of pine. Pine seeds do not germinate well unless they are in mineral soil. So, there is an overall change in the population of trees in the San Bernardino Forest. Many of the weed trees such as the black oak, incense cedar, and white fir tend to take over from the Ponderosa, Jeffrey pine, and then these weed-type trees, as we speak of them, are more fire susceptible, too. It is a degradation of the forest in that sense.

There was no effect on wildlife that we could measure, but that is a very difficult thing to look at.

I would like also to mention, back to the agricultural crop, things that we were not doing at Riverside but studies up at Parlier, which is the agricultural experiment station about 16 miles southeast of Fresno. Dr. Brewer has been looking at a number of crops there. The most recent one, and he is still running this year, is Thompson seedless grapes. The Thompson seedless makes up about 50 percent of the production in the San Joaquin Valley, 50 percent of the grape production. He is finding from 18 to 28 percent reduction in the crop due to ozone. He also ran three varieties of cotton, the SJ-2, the same one that we used at Shafter, and the SJ-5 and the SC-1. He found significant reductions in the SJ-2 production equal to between 15 and 20 percent crop loss.

In the other two varieties he did not find crop loss from those in ambient ozone. This demonstrates the fact that there is variation between cultivars, varieties, species of plants to the ozone.

The SJ-5 and the SC-1 cotton were developed by the cottonseed producers organization in the valley and were selected on the basis of their resistance to ozone. So, it is not too surprising that those didn't get injured.

He also ran alfalfa in the moapa variety that used to be quite prominent in the valley. He had heavy losses from that, up to 15- to 18-percent crop loss on the moapa. He compared that with the WL-512 alfalfa and got no significant crop loss with that.

So, these are some of the effects on agriculture and tree crops in the area that have been looked at.

I would like to mention some projects that we are now involved in. One was mentioned this morning, working on the cooperative study on the effect of ozone and SO_2 on epiphytes. This is the selection of wild orchids from the Florida Everglades. These are now being grown at UC Irvine. Then we will use our fumigation facilities to determine susceptibility of these plants to ozone and sulfur dioxide.

Dr. Miller at the Forest Service, at our research station, is working on some of the Park Service and Air Resources Board in fumigation in the field of species of national park species. Also, Dr. Temple in our group now has the National Park Service support to look at vegetation in the Joshua Tree National Monument for its susceptibility to ozone. He is growing many of the native plants on our campus now to expose them to ozone.

We also have another project, the acid fog and ozone mixture or sequential fumigations with that. We first ran radishes and lettuce and found no synergistic effect of the two pollutants, although we got injury from both the acid fog as it was artificially put on and from the ozone. We are now starting three of the forest species to continue that type of work.

[EDITOR'S NOTE.—An outline entitled "Vegetation Response to Air Pollutants" submitted by Dr. Taylor may be found in app. II. See table of contents for page number.]

Mr. VENTO. Dr. Taylor, this is, I think, really very, very good information. Obviously you stand as a leader in your area, at least as circumstances have evolved with regard to ozone damage. I guess probably when you began this research, you heard maybe some of the same questions that you heard today with regard to various types of air pollution problems and with regard to acid rain.

I take it that we all understand the reason that you have been invited is because of the early work that you did in terms of ozone and the fact that that has been now demonstrated to be a problem in the parks. Clearly, the types of species that you worked on, not just the agricultural or economic species, but the other types of wood species are the same types that exist in Sequoia/Kings Canyon and other areas. Isn't that correct?

Mr. TAYLOR. That is right.

Mr. VENTO. I mean, the inference and the fact is that they are being damaged in the same way that these plants that you have examined. There is no question but that they are being damaged.

What do you think? Here we are, a policymaker and a scientist. In your vein, what is it going to take? How much longer before we start getting back information on this acid rain? Obviously we need more cooperation. We need more of a data base. What do you think, is it going to be 2 years, 3 years, or are we talking decades?

Mr. TAYLOR. Well, I think it is liable to be decades on this to get a great deal of information in the West. I don't know the situation back in the East. To my knowledge, there is no evidence of acid deposition injury to vegetation in the West in any general sense. Now, close to local sources, yes, we get deposition when they blow the scale from stacks and it goes through a cloud or through fog. Then we get deposition of acid for a mile or so from it. But in general I know of no one that has demonstrated that acid precipitation in the West is—well, I don't think they have seen symptoms in the field.

What we need to do is just like we did with the ozone: Go back to experiments where we can control the acid and find out——

Mr. VENTO. When you say acid damage, you are talking about acid damage on plants.

Mr. TAYLOR. Directly, yes.

Mr. VENTO. I mean, you are not talking about other types of aquatic or visibility because, clearly, they are demonstrated.

Mr. TAYLOR. Yes. I have no expertise there at all. So, I would not speak to that, just to vegetation, just to plants.

Mr. VENTO. In other words, the acid deposition obviously—dry deposition, of course, is not being adequately monitored.

Isn't really ozone, though, with nitrous oxide, you are talking about an oxide, an NO type of output, aren't you, in order to come to the ozone type of problem? Nitrous oxides are a more serious problem in the West. Therefore, ozone constitutes a more serious problem. Dr. Taylor?

Mr. TAYLOR. To start out with, may I correct you?

Mr. VENTO. Please do.

Mr. TAYLOR. It isn't nitrous oxide. Nitrous oxide is N_2O. It is nitric oxide, NO, that is produced in combustion. This is a combination of nitrogen and oxygen from the atmosphere to produce nitric oxide. When this hits the atmosphere, then it oxidizes, due to nitrogen dioxide. That is the key material for the production of ozone and peroxyacetyl nitrate. It photolyzes when it is exposed to a short wave length light. It becomes an unstable molecule. And if there is some unsaturated hydrocarbons around, then it breaks down, and ozone accumulates, and this other compound, panperoxyacetyl nitrite, accumulates.

Mr. VENTO. I appreciate that. And that is a manmade substance, a serious problem, and obviously constituted damage. It affects our parks. It affects our agricultural resource.

I guess the thing we would all like to do is put a dollar amount on this in the San Joaquin Valley.

Mr. TAYLOR. Well, this is one of the reasons that we are trying to run this so-called NCLAN, or national crop loss assessment. We are going to have to balance the benefits with regulation costs. I think the public is going to demand that. So, what we would like to know is how many billions of dollars nationally are we losing from these pollutants. And that is not only crops but that is parks, forests, native vegetation.

I think the only thing that is a mitigating process is going to be control at the source.

Mr. VENTO. We had some acid rain bills in here, as an example, or bills that limit nitric oxide. If we are talking billions of dollars, basically those programs can be funded on the basis of some billions of dollars worth of damage. I think if we can demonstrate that, we have something.

One of the things I would hope—are you aware, Doctor, you pointed out—and I think the tremendous cooperative national project going on in terms of Riverside and Argonne and Lawrence Livermore and the USDA laboratory stations, and so forth—I haven't got all of them—but is the Park Service actually cooperating and benefiting? Do you think that there is some direct transfer of information that could help? You sat through most of these hearings.

Mr. **Taylor**. Very definitely. From this crop loss type of research, there is information there that can be directly transferred to the Park Service. There is going to have to be comparison of species of plants and their susceptibility in the Park Service with the performance of agricultural crops. Then that data can be pooled.

Mr. **Vento**. Dr. Briceland is sitting right behind you. I am sure you are familiar and have met him. I wouldn't be so presumptuous as to do so but, obviously, I hope he has heard what was said and that that would be possible, to utilize some of that.

What I am trying to do is sort of short circuit some of the need here in terms of the data base and use what we have, to save some money and save some time.

Mr. **Taylor**. I think it is save time more than anything, because there are still experiments that you are going to have to run on this to compare native species with agricultural crop species. But there are other things involved, too. The collecting of data on ozone and SO_2 levels throughout the Nation, in other words, a lot of that data is being collected right now and put into computer usable form. So, this should be helpful.

Mr. **Vento**. You don't hold much hope out for modeling of some of this acid deposition problem, the wet and dry, and so forth?

Mr. **Taylor**. I guess I am of the old school; I need to be shown on the modeling. It looks pretty rough and crude to me so far. But, yes, I have seen models work quite well.

Mr. **Vento**. I would hope that we could do some modeling in that. Obviously, it is such a severe problem in terms of the buildup and some of the other things, especially with regard to other species. Vegetative species are a problem insofar as you have indicated. As they become weakened by ozone damage or by other types of damage, all of a sudden you have got a forest fire or an infestation of insects or other types of disease.

My staff was saying to me that in Shenandoah they feel that the tent caterpillar is going to cause a lot more problems because of the weakened condition of some of the plants and so forth there.

Mr. **Taylor**. Some of this work has been done. Boyce Thompson research institute has done some, looking at exposing plants and then feeding these to insects and their selection, and this type of thing.

Mr. **Vento**. I am nervous. I have been looking at the clock, Dr. Taylor. I don't want you to be sitting out on the freeway. So, let me thank you for being patient and providing this input and your pioneer work in terms of ozone damage. I hope that we can call you back and have a chance to visit in a more leisurely manner at some time. Maybe when I come to California I will be able to do that.

Thank you very much, Dr. Taylor.

Mr. **Taylor**. Thank you very much for your appreciation of my problem.

Mr. **Vento**. Let me turn now to the other resource people that we have here, Mr. Hermann and Dr. Bennett. We already had some input from you concerning the vegetative. Did you have any specific order that you wanted to go in, Dr. Bennett?

What would you say it is going to take, in terms of the national parks in order to deal with some of these problems, Dr. Bennett? Do you think there is a need for—how much more monitoring do you see realistically being put in place on the sites?

Mr. BENNETT. I am not in charge of monitoring programs for gases. But in terms of monitoring for biological effects, we have only covered about maybe one-fourth or one-fifth of the parks that probably need the kinds of plots and the kinds of projects that we have been doing.

Mr. VENTO. Let me take the question to you then asked of Dr. Taylor. Are we ready to do some modeling?

Mr. BENNETT. Probably not. We need so much more baseline information, basic information on sensitivity of species. I don't think we are ready for the kind of modeling we would do in looking at forest response, for example.

Mr. VENTO. What do you need primarily? What do you want to see come back in terms of monitoring in order to address the concerns that should be expressed?

Mr. BENNETT. We need a lot more information on baseline levels of the most important pollutants, ozone, and sulfur dioxide. We don't know their concentrations in a great many parks. If we knew their concentrations, we could make some sort of judgments about potentials for effects on vegetation in those parks. But we just don't have enough of those kinds of monitors out there.

The pollutants of concern for vegetation are ozone and sulfur dioxide.

Mr. VENTO. Let me put you on the spot. How much coordination have you done with people like Taylor?

Mr. BENNETT. They are running a program on agricultural effects in agricultural areas. Our national parks aren't in those areas, you see. Our national parks are in remote areas, in mountainous areas, where there aren't these kinds of crop studies going on. They are very hard to get in there. There is often a lack of power, electricity available to put in the kind of monitoring equipment.

A lot of the work being done that Dr. Taylor referred to is done at laboratories near universities, near cities, where they have the ability to dedicate a ground area and power to long-term installation of these fumigation chambers. We can't do that.

Mr. VENTO. You think that that is applicable then—I think there are probably some techniques there that are valid.

Mr. BENNETT. We have used techniques in the national parks. We simply can't use their facility all the time.

Mr. VENTO. You don't think that it lends itself to a lab type of environment? You think you have to do only field testing with regard to the vegetative effects, air pollution quality?

Mr. BENNETT. I think if we want to make a case for effects on parks, we have to do the work in parks.

Mr. VENTO. I think that the problem that that rings up, of course, is that you have to see the complete demise, for instance, if indeed with regard to the Great Smoky Mountains problem, where you have 80-percent damage, ozone damage, I expect, to red spruce and higher elevations and 40 at lower, as was indicated here. This has been work that has been done by your group. The problem, I guess, is apparent. It is apparent that, if we are going to wait until every park, we have that type of documented record, then don't we have extreme damage and maybe irreversible damage that will occur?

Mr. **Bennett**. We are starting some projects where we use extremely sensitive species to indicate the onset of a small increment of pollution into a park. We can use species, some are shown on our poster here——

Mr. **Vento**. Lichen.

Mr. **Bennett**. Lichens, milkweed, these are the first species to go or to show sensitivity before the things like the effects on spruce that you heard about earlier. If we use those, the canary-in-the-mine approach, to indicate the onset of it, we will hopefully get information before the kinds of catastrophes you heard about will occur.

Mr. **Vento**. The lichen, you think, is appropriate for acid rain, I guess, for sulfur dioxide, nitrous oxide type of——

Mr. **Bennett**. That is correct.

Mr. **Vento**. But it is not appropriate for ozone, is it?

Mr. **Bennett**. No.

Mr. **Vento**. Because in the Great Smoky Mountains they still have that.

Mr. **Bennett**. That is correct.

Mr. **Vento**. The problem is that you think that the ozone levels are serious enough then to warrant action? I mean, obviously, what type of indicators do you have like that for ozone?

Mr. **Bennett**. We have, as shown here, the common milkweed, eastern white pine, a number of other species that are sensitive at low levels, just above the background levels.

Mr. **Vento**. Are the white pine mixed in adequately to do the job with regard to some of these areas or not?

Mr. **Bennett**. We have installed some 33 plots of eastern white pine in the Smoky Mountains National Park to monitor for low-level effects of ozone.

Mr. **Vento**. Well, you don't think the red spruce is quite as sensitive?

Mr. **Bennett**. No, we don't know. We are fumigating it this year. We are exposing it this year to find out.

Mr. **Vento**. The point is, though, that, if you have got this type of damage occurring to them at higher elevations, they may be barren by the time—how long do you think this experimentation or this review, data base building will take?

Mr. **Bennett**. We should know on red spruce, I think, by the end of the year.

Let me clarify that——

Mr. **Vento**. The end of the year?

Mr. **Bennett**. For ozone sensitivity.

Mr. **Vento**. Yes.

Mr. **Bennett**. Because it only takes about a year to do a species. The red spruce response that you heard about earlier, it is not clear that it is due to ozone, though, let me clarify that. It is thought to be due to a complex of pollutants, including acid rain and ozone and heavy metals, not just ozone.

Mr. **Vento**. So, you think it is both acid rain and ozone and heavy metals as well? Have you detected trace elements in there of higher concentrations than normally would be expected?

Mr. **Bennett**. Yes. In the red spruce, in the Smokies, in fact, the Oak Ridge National Lab has just completed a study analyzing heavy metals in the tree rings. They have found during periods of activity at the smelter south of the park that heavy metals were elevated in the tree rings and that growth decreased during those same periods.

Mr. **Vento**. What are we talking about, mercury, lead?

Mr. **Bennett**. Yes, lead, mercury, iron.

Mr. **Vento**. Let me turn to your colleague. Mr. Hermann, you are the Director of the Water Resources Field Support Laboratory. We have had probably not enough discussion about water resources. What do you think the status of that is? Where do we have to provide greater emphasis in terms of monitoring sites? Are we weak? Are we strong?

Mr. **Hermann**. Mr. Chairman, my involvement has been mainly with the National Acid Precipitation Program, which is the interagency effort. That involvement has resulted in the establishment of four intensive research sites in the National Park Service which are aimed at establishing baseline information at the ecosystem level.

We have not at this time developed any hard data that would be able to say anything about effects of parks except that you can draw logical conclusions from what we know from outside, the type of things that Jim Galloway said yesterday, the types of things that Ellis Cowling talked about yesterday.

Mr. **Vento**. Those were the fact that in terms of acid rain and elevated levels. What about the comment this morning concerning—have you identified other areas where there are potential problems with insect larva in streams and so forth that are affected by change in the pH?

Mr. **Hermann**. Mr. Chairman, we know quite a bit about some of the aquatic systems and their sensitivity to acidity. If you look at lake cores, for instance, the historical record, we can use diatoms in those cores as an assessment of acidification historically, going back and looking at what has occurred during the cultural revolution. We have done that in some areas. We have done it in one park. It has been done in the East quite a bit by acid rain researchers. They are dealing with the national program.

What we can say from that information is that whether or not a system has been acidified. We have only done that in one area—that is Rocky Mountain National Park. What we found with that evidence is that the systems have not been acidified up to this point. However, they are very sensitive systems. Should there be changes in the levels of atmospheric deposition, we would expect to be able to measure these changes.

Mr. **Vento**. You have done that on only one park in the West? Is that what you are saying?

Mr. **Hermann**. That is correct.

Mr. **Vento**. In the East you have done it in numerous parks?

Mr. **Hermann**. We have not done that in any other park. We have done it in one park.

Mr. **Vento**. The whole point is that I get sometimes the feeling that there is the tendency to rediscover the wheel with regard to some of this. Now, there have been lake cores taken from lakes that are close. Is any of that data applicable to park resources?

Mr. **Hermann**. There have been cores taken in the Northeast. The data is applicable to park resources.

Mr. **Vento**. What does it say?

Mr. **Hermann**. What the data in the Northeast shows is that in some lakes there has been acidification and that that acidification has changed the nature of those lakes.

Mr. **Vento**. That doesn't tell you if that came from rainwater?

Mr. **Hermann**. There are some lakes where the conclusions that scientists who did the research, of the scientists who did the research, are that those lakes could not have been acidified by anything other than atmospheric deposition.

Mr. **Vento**. So, it is a positive demonstration of acidic deposition in New England lakes that are similar to the resource within the national parks such as——

Mr. **Hermann**. It would be similar to lake resources in national parks; yes.

Mr. **Vento**. Which parks, Acadia?

Mr. **Hermann**. We might be able to apply it to Acadia. We don't have any solid data out of Acadia indicating acidification, however.

Mr. **Vento**. If you took lake cores, might you find some?

Mr. **Hermann**. There has been some work done in Acadia. I am not familiar with that work. I couldn't draw a judgment on that work.

Mr. **Vento**. State activity or private contract?

Mr. **Hermann**. There was some work done locally by the University of Maine.

Mr. **Vento**. Do you think that will demonstrate whether this question can be answered by you and by others or not?

Mr. **Hermann**. I think that work will be able to speak to the history of acidification in some of the waters in Acadia National Park.

Mr. **Vento**. Do you know when that will be published?

Mr. **Hermann**. That work is being published right now. Some of those reports should be out imminently or are out imminently. I have not seen the final report.

Mr. **Vento**. The aquatic resource seems to be one of the first that is impacted by acid rain. Don't you agree, Doctor?

Mr. **Hermann**. We don't know that. It has been the most obvious impact that we have had to deal with. It was the first issue that we dealt with in this country, which was basically because of the Norwegian experience and then because of the Northeastern studies that were done.

We started with the aquatic system so that some of the work that has been done nationally in the aquatic systems is a little bit ahead of what is going on in, say, the terrestrial systems or the vegetation systems. My involvement, however, has been mostly in the establishment of these long-term studies which are meant to be baseline sites against which some of the most impacted sites can compare.

Mr. **Vento**. When you say long term, what are we talking about?

Mr. **Hermann**. Through at least the end of the national atmospheric program, which would be 1990-92, depending on whether you count from the funding or the beginning of the act in 1980.

Mr. **Vento**. Do you think that will be conclusive?

Mr. **Hermann**. In some cases, it will not be conclusive.

We are dealing, as Jim Galloway said, with changes that sometimes take decades.

Mr. **Vento**. This afternoon, the chairman pointed out, he suggested that, when they turn the smelters down for a while in some areas of Arizona or other places, basically turning off some sulfur dioxide, nitrous oxide emissions, that that would be the opportunity then to measure this. What do you think of that sort of a short-term type of solution?

Mr. **Hermann**. That is not my area of expertise. I usually pick it up after it hits the ground. I would say that, if there is an experiment where you can shut off air pollution and then look at deposition and track it, that that would be very useful information.

Mr. **Vento**. But in the long-range transportation of some of these pollutants, that would really not be applicable, would it? It would be just a reduction in the total mix. It might be 1 or 2 percent, it might not be very significant.

Mr. **Hermann**. I can't speak to that, Mr. Chairman.

Mr. **Vento**. I guess I should have asked the air pollution people that when they were here. I just didn't want to get into ruining the chairman's perfect experiment. I thought we'd let it live for a while before it came up.

I think this has been useful. Of course, again I think it is encouraging to note the work of the States. I don't know, Mr. Bennett, if I have given you an adequate opportunity to explain or to say what you had to say in terms of long-term trends, but I do know that the work that is reflected in some of the other park superintendents and their answers and responses has been very helpful to the hearing.

Are there any other comments, Mr. Bennett?

Mr. **Bennett**. I would like to make one more comment.

Mr. **Vento**. Please do.

Mr. **Bennett**. It is in regard to a point on some of Dr. Taylor's testimony.

The NCLAN project is aimed at estimating dollar losses from crops. The kind of work is done by exposing single varieties of crop plants to controlled amounts of pollution. In national parks and in wilderness areas we cannot use plants that way. What we have are mixtures of different types of varieties of any one species. The park is made up of many, many different types of what are called genatypes for each one of these species.

One of our most recent studies has generated evidence that the most long-term effect that we are finding in the national parks now is an evolutionary one. We are finding that the populations of species in our most polluted parks are not as sensitive anymore as the populations of the same species from our less polluted parks. We interpret this to mean that evolution has occurred. Selection has taken place against the sensitive individuals or genatypes of those species in those parks.

We can't get at that, put a dollar value on that like they can in the NCLAN project. This is a much more insidious effect and a much more difficult one to get a handle on. But we are getting evidence that this is taking place.

Mr. **Vento**. I think that Dr. Taylor—I certainly don't want to speak for Dr. Taylor, but he pointed out his work was on woody species as well, that were the same types of species. And I guess in that particular case the correlation is absolute.

Mr. **Hermann**. We can use that. We have used that information.

Mr. **Vento**. I understand that. Obviously we don't expect you to start growing cantaloupe in the Rocky Mountain National Park.

I think that looking at the techniques, looking at the study, trying to accelerate this and push this, but we don't want to push it beyond what it would be useful for. We have made enough mistakes with the science of air quality anyway, like stacks and a few other things along the way, where it really only transported the problem to somebody else's environment and out of our own.

Mr. **Hermann**. As Dr. Taylor mentioned, we are in fact using his laboratory for studies on the sensitivity of species from three national parks now.

Mr. **Vento**. I think it is very useful to see where we can use and accelerate this and use whatever techniques are possible. I don't really find a conflict. I think members of the committee in the record will certainly show the difference in economic species. But in this case some of the same environment is almost contiguous with the Sequoia/Kings Canyon National Park. Is it not, in terms of the San Joaquin Valley? Isn't it almost absolutely contiguous?

Mr. **Hermann**. Yes.

Mr. **Vento**. The environment isn't that different. This is the effect on these crop losses. Grapes indicate apparently a very great sensitivity. I don't know if it's the leaf structure, the cuticle, or what it is. But they show a very great sensitivity. I expect if they are wild grapes in the park that they wouldn't be far behind that, right?

Mr. **Hermann**. Yes. In fact, we find ozone spots on leaves on wild grape in many parks wherever we look at it.

Mr. **Vento**. Grape is one of your sensitive species, I guess——

Mr. **Hermann**. Right.

Mr. **Vento** [continuing]. Along with milkweed for that particular purpose.

Mr. **Hermann**. That is right.

Mr. **Vento**. This has been very good. I hope that we are not just developing a record but meeting some of the scientists, who I am getting increasing respect for working the Department of the Interior. I appreciate the opportunity and the way that you come forward to spend your time with us over the course of these 2 days.

Thank you very much, Dr. Bennett and Dr. Hermann.

Let me take the next panel of scientists that we have. Ms. Susan Sherwood is project director of the Cultural Resources Acid Rain Research Program. Mr. Edward McManus is museum specialist, metal conservator, North Atlantic region.

Welcome to the committee. Ms. Sherwood has had already an opportunity to visit with us and respond to Congressman Seiberling's questions with regard to cultural resources.

PANEL CONSISTING OF SUSAN SHERWOOD, PROJECT DIRECTOR, CULTURAL RESOURCES ACID RAIN RESEARCH PROGRAM, AND EDWARD McMANUS, MUSEUM SPECIALIST, METAL CONSERVATOR, NORTH ATLANTIC REGION

Mr. VENTO. In some of the testimony with regard to the superintendent from Mesa Verde in Colorado, he pointed out that we are almost better to leave some of these ruins or these cultural resources covered with earth as opposed to exposure and some of the absolute damage.

As I understand the preliminary testimony, the preliminary discussions that we had, Ms. Sherwood, most of the work that you are doing, or at least a goodly part of it, is actually being done in a laboratory setting. Is that accurate?

Ms. SHERWOOD. It is more accurate to say it is not being done in a Park Service setting or within the bounds of a national park. The work is being done in the laboratory as well as controlled field sites, very much like the fumigation chambers that the vegetation people and forest effects people have talked about. Those field exposure sites, at this point we have four for testing the durability of marble, limestone, seven different construction metals and paint. The paint and the metals work is funded by the Environmental Protection Agency. The National Park Service is sponsoring the stone research.

Mr. VENTO. That permits the acceleration of the activity and the accumulation of information then at a more rapid rate?

Ms. SHERWOOD. No. The use of the field sites is for the purpose of separating out the various polluant facts. Our sites range from the Adirondacks to Chester, NJ; Washington, DC; and a site near Raleigh-Durham, NC. We hope to add what we would call a dirty site, or a more industrial site, in the Ohio Valley next year and perhaps a more pristine site in Canada, also next fiscal year.

The purpose of these five, four, or six sites is to look at the behavior of identical materials under different environmental conditions to try to sort out which of the factors are causing which portion of the damage. It does not by any means accelerate the rate at which we can acquire information. The stone takes a certain amount of time to decay, and there is not a whole lot we can do about that.

Mr. VENTO. Mr. McManus, you specialize in terms of metal. Apparently there have been some efforts to protect some of these resources. I guess one of the superintendents from Gettysburg, Mr. Davidson, indicated that you have attempted to try and wax or do other process to some of the metal statues. I assume he was talking about the metal ones. I don't think you could wax the limestone statues.

Mr. McMANUS. That is correct.

Mr. VENTO. Do you want to comment about that?

Mr. McMANUS. Surely. I have been with the North Atlantic region for about 5 years. One of my concerns has been for a long time the effects of acid rain and the environment on these materials, these materials that are outdoors. The whole purpose of the coating system is to prevent the interaction of the environment with the material in question.

The sculpture in the North Atlantic region has been ignored for many, many years. It is something that we have taken for granted. My concern is that in the past few years rates of corrosion have been increasing because of the effects of acid rain.

We worked with the executive office for air quality control for the State of Massachusetts for a while. They took upon themselves an effort to monitor the effects of acid deposition on cultural resources. That project has since been abandoned. I have also worked with the museum and the MFA to develop various types of coating system.

Coating systems are effective. We have certain problems, however, which we cannot treat. One of those is the Statue of Liberty, for example. I feel that, with regard to monitoring the effects of acid rain and acid deposition within the North Atlantic region, we have been negligent. I think that we need to do more with cultural resources.

Mr. VENTO. This monitoring then, of course, would be important. Your feeling is that the rate of deterioration of these has markedly increased as air quality pollutants have increased. Is that right?

Mr. MCMANUS. That is correct. However, there is no hard data to substantiate that.

Mr. VENTO. In other words, looking at the fact that the statues are, I guess, melting—in other words, something is causing that. That has not occurred previously in history. You have actually monitored this. What causes it you don't know, but the statues are becoming defaced.

Mr. MCMANUS. Yes, that is true.

Ms. SHERWOOD. Can I just supplement that?

We are beginning a project this summer which we hope to have completed by the end of the year, looking at replica bronze statues across the country. These are statues that were cast from effectively the same mold. So, we are not introducing any variables, material or configuration. The particular statue we have chosen was the Hiker, a Spanish-American War soldier. They have been put from Minnesota—in fact, the first one was put up on the University of Minnesota campus in 1907, I believe, or 1917.

Mr. VENTO. What is the title of the statue?

Ms. SHERWOOD. It is called the Hiker. We have one in Washington, which is the latest one, which was put up about 1967. It is on Memorial Drive. As you drive over to Arlington Cemetery, you will see there are statues along. He is in a uniform and carrying a gun.

These are widely distributed geographically across the country. We have selected those that are the oldest and that have not received any conservation treatment. We will then go out and look at the current condition and the corrosion to try and get some idea of the cumulative nature of air pollution damage.

We know, for example, in the rural areas they have had less exposure to air pollution than in the urban areas. We will try to piece together some of the environmental history that goes along with these statues so that we can on a more quantitative basis address the kinds of things that Ed McManus and his contemporaries have seen in other areas.

Mr. VENTO. How many Hikers are up?

Ms. **Sherwood**. There are about 50 Hikers. We are going to look at about 12 to 15 of them.

Mr. **Vento**. That is very interesting. That brings up the Washington area here. This is an area where there are a lot of cultural resources in terms of statuary, and so forth. Is this area receiving special monitoring?

Ms. **Sherwood**. No, sir; it is not.

To followup on your original question, which is how much work was or was not being done in national parks, we are doing long-term monitoring at two national parks: Mesa Verde, which you heard about earlier today; and Independence. Our funding provides for an addition of one intensive monitoring site per year. So, we can conceivably over the 10-year acid rain program have 8 to 10 monitor resources.

Mr. **Vento**. This is one place where you probably look to the States. Obviously you have indicated that Massachusetts, which had a program, has come to its demise, I suppose for budgetary reasons. They didn't discover all the answers and folded up their tent, I guess.

What about the State participation in this area? I mean, if metal statues are the topic or stone statues or whatever. What about States though?

Mr. **McManus**. The State was very interested in it initially. I think it was dropped for funding reasons primarily. However, we are thinking about starting another program similar to that, initiating it within the Park Service, and including other agencies such as the NIC, the National Institute for Conservation, which is directed now by Arthur Beale, and perhaps bringing in other local agencies in the New England area such as the Society for the Preservation of New England Antiquities. It is going to be a joint effort, I think, and it should be a joint effort because we all have a stake in it. And New England, of course, as you know, is one of the areas that is severely hit by the effects of acid rain.

Mr **Vento**. Ms. Sherwood, of course, I certainly want you to respond to that, but also the question that comes to mind is this. Yesterday we had the American Institute of Architects and their representative testify on the substantial work that they have done and their concerns about these air pollution problems. Besides the question with regard to State, what is your relationship with such trade associations as the American Institute of Architects?

Ms. **Sherwood**. Let's begin with the State and other outside groups with which we cooperate on a co-funding basis. The National Park Service and the NAPA materials program have made tremendous efforts to leverage the amounts of funding that it has to increase the scope of its studies. We work closely with the Commonwealth of Massachusetts. The California Air Resources Board is beginning a substantial program looking at the effects of air pollution, particularly acid smog and nitrate compounds on materials, and not specifically cultural resources, but materials in general.

We have reviewed their project design. We help to review the bidders, the contractors who bid on the documents, and will continue to work very closely with California and Massachusetts, should it find funding again.

We have also been working with the Electric Power Research Institute, who is in the stage of request for proposals, to design a major program in looking at the effects of air pollution on materials.

All of these programs will be linked as much as possible because there is just not enough money around to duplicate effort. So, we are doing that.

With respect to the American Institute of Architects and other trade associations, we use them as a consulting basis. The witness yesterday was one of the chairmen for the peer review of the National Acid Rain Program and materials last year. The second peer review chairman was from Texas Instruments and a major player in the National Association of Corrosion Engineers. There are good linkages with both of those groups as well as with what I believe is called the Federation of Materials Societies. There are a vast number of professional associations related to different materials, copper, iron, et cetera. They put them all together and call them the Federation of Materials Societies. We are working closely with them.

We have gone to rather than professional societies, trade associations such as the Portland Cement Association and some of the painting associations for advice on how we should proceed in our research as well as to draw from their research what they know or may not know about the effects of air pollution on materials.

The long-term trend in this kind of academic or scientific research has been to look at the performance of materials to make a better paint formulation or develop a better alloy, not to identify which of the air pollutants have caused the problem. Don't worry about what caused the problem, we'll solve it for you.

While there have been over 30 years of long-term testing of materials, very little air pollution monitoring has been done at those same areas.

Mr. **Vento**. It is a question of whether you are fighting a losing battle or not. If we have things that we cannot reproduce like these pre-Colombian ruins or Mesa Verde or other monuments that have been built 100 years ago, then it becomes very difficult. You have to take a little different approach. But I do think that the American Institute of Architects, Mr. Stein had a rather positive attitude with regard to working with this issue and perhaps developing a position as an organization with regard to stronger law, stronger enforcement of laws and protection of national parks, I guess, than just cleaning up the environment in general.

I find it encouraging. It is, obviously, a pleasure to have both of you testify today. Thank you for your patience. We look to a continuing working relationship with you in terms of addressing this important problem in our national parks. Thank you.

The next panel is Mr. John Peine and Mr. David Parsons, who is with Sequoia National Park in California.

PANEL CONSISTING OF JOHN PEINE, DIRECTOR, UPLANDS FIELD RESEARCH LABORATORY, GREAT SMOKY MOUNTAINS NATIONAL PARK, AND DAVID PARSONS, SEQUOIA NATIONAL PARK

Mr. VENTO. We wanted you both to come because of what appears to be a critical problem in your parks in which you are now working, both in the Great Smoky Mountains and in Sequoia National Park. Both of these parks have demonstrated ozone damage.

Mr. Peine, you must have been responsible for some of the experimentation that indicated the ozone damage in the Great Smoky Mountains. Mr. Parsons, I am sure you are familiar with the damage that has occurred in Sequoia along similar lines.

How extensive is the damage in Sequoia, to refresh my memory? What is the percentage of ozone damage on the pine trees there? Did I remember it being a third of the trees showing ozone damage?

Mr. PARSONS. Yes. I think we were in the neighborhood of a third. That is based on permanent long-term plots that have been placed in the middle elevations of the park by the air quality office under Jim Bennett's direction. That is focused primarily on the yellow pines, ponderosa and Jeffrey pine, and more recently on black oaks, which are also in that 5,000, 6,000, 7,000 foot elevation.

Mr. VENTO. No definitive information on sequoias at this point, as I recall the testimony. Is that right?

Mr. PARSONS. The indications to date, based on both field observation and experimentation done this last year in Riverside, is that, when fumigated with ozone, sequoia seedlings do show ozone-like symptoms. That work will be replicated this summer up in the park in the elevation zone where the sequoias grow, to see whether it is extraplicable.

The problem they ran into last year is that the Riverside area, as you know, is down in southern California where they are high ambient pollution levels of other types. It gets very dry and very hot. So, the heat stress last year was especially considered to maybe make the data not perfectly applicable. So, that will be repeated up in the park this year.

The problem, of course, in this is that that is on 1- and 2- and 3-year-old seedlings. What we really don't know, with all of these fumigation studies, is how does that apply to mature trees out in the forest, and that's a whole other question.

Mr. VENTO. That is a very good point. Obviously, unlike Dr. Taylor's work, where they are looking for a resistant species or species tolerant to high levels of ozone, you don't have quite that choice with sequoias, do we?

Mr. PARSONS. No, sir. It's very difficult to breed different kinds of genatypes, either, as Dr. Bennett suggested is something we have to look at.

Mr. VENTO. Otherwise, we'll be spending a few hundred million dollars on doing the genatypes for sequoias, is that right? We just cut them down and use them?

Mr. PARSONS. Well, we don't cut them down very often, sir.

Mr. VENTO. No. Well, I think maybe we're doing it unbeknownst, I guess, or unaware maybe in terms of some of the damage.

Insofar as the species where there is damage, do you agree to the fact that there is a combination of factors from infestation and other types of plant related pathogens that affect these species or that they become more vulnerable in the sequoia? Have you observed that particular phenomenon?

Mr. **Parsons**. As a plant ecologist, I firmly believe that there are a number of stress factors acting on the giant sequoia as well as the associated species. It, by the way, grows in very similar habitat to the ponderosa pine, where the damage has been found. There are a number of stress factors, both natural stress and unnatural stresses. I think it is very difficult to sort these out. I think we have to look at the ecology of the species we are talking about. We have to try to understand what the natural stresses are.

If we have long dry summers like we often do in California and these individuals are put under some kind of drought stress, they very likely become more sensitive to pollutant stress. This is a difficult area. It is one where there is very little understanding on, especially when you are talking about mature—in this case several-thousand-year-old individuals.

Mr. **Vento**. I agree. I understand. I guess most people look at plant life in most of these areas as being sort of a delicate balance. When we put something in that changes it, we obviously shift that perceptibly perhaps in the wrong direction, giving way to other types of species. I guess Dr. Taylor called them weed species. I don't know if black oak—is that what you refer to as weed species?

Mr. **Parsons**. No. I would not refer to black oak as a weed species.

Mr. **Vento**. I wouldn't either. He did, though, I think. In any case, I think that probably looking at a mixed stand—in looking at most of these plants, you do find that there is at least some damage to ozone and that most species are not resistant. In fact, in Sequoia do you have any species of plant that you are prepared to say would be resistant?

Mr. **Parsons**. No. I don't think we have that information. I think we have only looked at a very few species. And this is certainly one of our concerns. I think, again, Dr. Bennett's work on effects has tried to look at what is known to be the most sensitive species. But when you are dealing with a park that has thousands of plant species and you've only looked at a half dozen or a dozen, you can't really be sure what you might be missing.

Mr. **Vento**. Well, we know that none are immune probably, at least the woody plants.

Dr. Peine, how about in responding to this? Do you disagree with any of the questions or responses that I have asked Mr. Parsons, or would you like to add to those comments?

Mr. **Peine**. I think I would agree very much that the complexity, of course, is something that has come up frequently here throughout the nature of this hearing and through the variety of disciplines that you have had approach you for discussion. I think that complexity can be very well capsulized when you look at ozone. The fumigation studies that have been done and are in the literature, there are 30 species in the Great Smoky Mountains that have been studied to show that they are in fact sensitive to ozone.

We are in the process of discovering new ones that have not ever been looked at before in the laboratory. Yet, when you get in the field, you don't know if the laboratory result is going to reflect what you might find based on your ozone monitoring data.

In our case, where we have maybe as bad an ozone situation as anywhere, the latest result from our white pine work is that 70 percent of the white pine studied exhibited some degree of damage, and 20 percent had a very severe damage. I think that that is the first species that we have really looked at.

Mr. VENTO. Why do you think that white pine is so susceptible to ozone damage? You talk about it being used as an indicator.

Mr. PEINE. I don't know the plant physiology myself. Maybe some other people here would suggest why that is.

Mr. VENTO. Any suggestions, any help? It is kind of unusual, I think, that that particular pine of all the pines would be impacted. It is generally a pretty well dispersed pine. We are talking about it existing in the East. It certainly exists in the Midwest, or at least it used to, before they built a lot of houses up there, and railroads, and so forth. And it exists in the West as well.

Mr. PEINE. One of the things that again, looking at the ozone question and looking at white pine, all we are doing at the present time is documenting the foliar damage. We really haven't documented, some people have done studies on this, but certainly not in the Smokies have we taken a long-term look annually to see the ultimate effect of initial ozone damage: What is it in terms of the retention of needles and dieback and eventual mortality? Does that occur at a greater rate? We are pretty sure it does, but we don't know to what degree.

It becomes very complex to fix a scenario beyond the initial discovery of the symptom to what the ultimate potential survival rate of the species might be.

Mr. VENTO. But isn't the work that has been done on the Black Forest in Germany, any of this going to be helpful or applicable? Can't we learn something from that? I mean, look, you know what you are saying is that some people say it takes 6 or 7 years to get the necessary baseline work done. It is according to whatever the congressional schedule is we put for the interagency task force study on acid rain deposition, and so forth, whatever they have added to it. I almost regret that I ever got involved in it, to some extent, because it seems to be an excuse not to do things. That's in my weak moments that I feel that way. But in my good moments, I feel that it was OK to move ahead with it.

Then they suggest we get this information. And then, by the time we take action, it will take another 5 years to really cut back on the sulfur dioxide, nitrous dioxide emissions.

Isn't there any way to take the information from the Black Forest in Germany, where they are experiencing severe damage, and apply it here? I mean, is this the only hope that we have, just wait until this information is done, or not?

Mr. PEINE. That is a very interesting question. There has certainly been an exchange of scientists promoted through EPA of European scientists and American scientists working on forest decline. Although I have very limited exposure to those people, in talking with them and Ellis Cowling——

Mr. **Vento**. Well, you shouldn't. I'll tell you that. They ought to be spending some money to send some of the scientists in our Park Service back and forth to these conferences. It's ridiculous.

Mr. **Peine**. I think that's a great idea.

Mr. **Vento**. Well, it's the truth. It really is silly not to have our people that are working in the same areas involved on a global basis in these types of exchanges.

Mr. **Peine**. Ellis Cowling has been a part of that exchange program. Even though technically the pollutants are a little different and the species don't seem to be reacting in the same way in terms of their stress symptoms, I think that there most assuredly are some very fundamental lessons to be learned from that. One of the most alarming ones to me is the degree of—you look at when the Europeans first discovered that there was a fairly significant problem with their forest stands, to the timeframe that they are being able to establish very high mortality rates, it's not a matter of decades. It is a matter of a very few years.

What we may be experiencing here is what they saw in their forests 6 or 8 years ago.

Mr. **Vento**. That is, of course, the concern. None of us want to say, I told you so. We are better off acting on the side of caution in terms of this and maybe attempting to reduce it rather than arguing. We will be arguing over the bones in a little while, over the carcass of what's left of these national parks and resources.

Obviously, they don't grow any sequoias in Germany anymore. So you have to stay on the west coast to do your best out there, Mr. Parsons. But some of the species are directly applicable, I think, to the Smokies and to other species that are common throughout our National Park System, in terms of Germany. Of course, we could get a number of Congressmen to go over there. In fact, I think there may be a trip even with this committee, if I understand one of my colleagues correctly.

In any case, I find your work very useful with regard to these parks. I hope that your perseverance and almost as the last witness—Mr. Green is going to get the prize for that. We have shed some light on it. I hope that we will be able to call on you as questions arise with regard to this.

You both, I take it, agree that the No. 1 problem facing both the parks that you work in, both Sequoia and the Great Smoky Mountains, is air pollution. Is that correct, Mr. Peine?

Mr. **Peine**. That is correct.

Mr. **Parsons**. Yes, sir.

Mr. **Vento**. It is the number one problem. How do you rank the other problems? How far behind are they on a scale?

Mr. **Peine**. If you look in the long term, they are pretty far behind, I expect.

Mr. **Vento**. In other words, this is critical. It is the number one problem now. It is the most critical problem. Our ability to deal with it is what, somewhat limited at this time, isn't it? We are pretty much bound by the existing standards and laws.

Have either of you participated in some of the background material, for instance, the point sources and class I? Isn't Smoky Mountains a class I area? It and Sequoia both are, are they not?

Mr. **Parsons**. Yes.

Mr. Vento. You are, of course, located in a nonattainment area in Sequoia, right?

Mr. Parsons. Yes.

Mr. Vento. That county which my colleague from California described as the nonattainment area. That is the problem there.

Have you participated in any type of permitting systems in developing the background material for those or not?

Mr. Parsons. No. I personally have not.

Mr. Vento. Other personnel in the park have been called upon to do that?

Mr. Parsons. Yes.

Mr. Vento. They have put in their input. They have had their consultation. And then what happens?

Mr. Parsons. I can't comment on that. I am not sure.

Mr. Vento. You cannot comment?

Mr. Parsons. We have had no new point source applications in recent years. The concern has generally been over long-distance transport and emissions from transportation.

Mr. Vento. My county is a nonattainment area, too, as a matter of fact.

Mr. Peine, do you have any comments on that? In the permit process, of course, you have a much larger range of urban settings and other possibilities. There have been permits granted around that area, I expect.

Mr. Peine. Yes. The recent large one that was—actually, the project was canceled before there was any real confrontation. But I think, if you ask the hard question, the Park Service is doing all this fine work and trying to define the problems. And yet they don't seem to be in a big business of denying permits. What is that? Well, I think it's primarily because the pollution problems in the parks are regional and national in scope. The new point source pollutants are certainly contributing to it, but they are not the fundamental cause of the problem.

Mr. Vento. In other words, they just add a quarter of a percent to the total problem that the Smokies face. In other words, the problem is much greater in some powerplants we have grandfathered in some other locations. Is that right?

Mr. Peine. Particularly in the Smokies. In the East, that is, where we have 12 times the sulfur loading of Glacier, eight times the Grand Canyon of the fine particulate sulfur, that is most assuredly the case. And it is pretty hard to sort out the impact of a new point source when you are in the situation we are in.

Mr. Vento. Thank you very much, gentlemen. I think that that is a very good insight, Mr. Peine, with regard to the problem. Thank you very much for your participation today.

As I indicated, the prize for patience goes to Mr. George Green, who has been waiting patiently. We are thankful. We had planned differently, Mr. Green. The best plans that we had here were to be done at 2:30 in the afternoon and be able to get out for tea. So, here we are.

Let me assure you, we have copies of your statement, Mr. Green. That will be made part of the record. I invite you to summarize and to proceed.

Mr. **Green**. Thank you very much, Mr. Chairman. I sincerely appreciate your giving me the opportunity to complete this afternoon and not be held off to another date.

I will not insult your intelligence. I realize you can read. So, if you would please accept the statement that I have prepared, I would like to take a moment or two, though, to highlight an item. I recognize the lateness of the hour. I will be as brief as possible.

[Prepared statement of George Green may be found in app. II.]

STATEMENT OF GEORGE GREEN, PUBLIC SERVICE CO. OF COLORADO, REPRESENTING WESTERN ENERGY SUPPLY & TRANSMISSION ASSOCIATES

Mr. **Green**. Mr. Chairman, I admire you for the last 2 days. It has been very, very informative. To be able to sit here and absorb this, I have been very impressed.

For the record, my name is George Green. I represent an organization called the Western Energy Supply & Transmission Associates, more commonly known as WEST. WEST is basically a planning and research organization comprised of 21 members from various sectors of the electric utility industry. These members include not only investor-owned utilities but public-owned utilities and rural electrics. The organization was formed in 1964, and one of its basic primary objectives is to conduct research and specifically research into air pollution control.

We have conducted many research activities over the past years, to include several aspects related to the question of acid rain, atmospheric deposition both wet and dry, soil and lake chemistries, plume characteristics, and studies related to visibility effects.

Our concern in wishing to visit with the committee today is to discuss with the committee some of those items related to research and some of the misconceptions that may have occurred regarding Western air quality. Let me explain for a moment just a couple of these that have been brought to mind.

I have heard today mentioned several times the Navajo powerplant and the Grand Canyon. I would like to bring to the attention of the committee that as far back as 1977 the National Parks and Conservation Association testified before the Congressional Health and Environmental Subcommittee—and I quote—

> There is evidence that some areas that in the past had 100 mile visibility now have only an average of 30 mile visibility. Much of this can probably be attributed to emissions from powerplants such as the Navajo.

Visibility measurements made in the vicinity of Navajo by EPA then reported at a national symposium on plumes and visibility in November 1980—reported the studies that did not support this perception. There was even evidence available at the time that repudiated that perception. It appeared subsequently proven that the major contributor to haze in Grand Canyon was the urban plume from southern California.

I think several people alluded to that. In fact, there was a drawing shown earlier with a large arrow pointing to southern California and Grand Canyon area.

Later that year, the Committee on Interstate and Foreign Commerce concluded—quote—"It would be impracticable to require a major city, such as Los Angeles, to meet the same visibility standards as the Grand Canyon"—although I think that might be commendable if they could. They did not recognize at the time the tremendous impact such a megalopolis has on the visibility some 500 miles away.

Another concern—and I think we have heard it expressed also—is how do you monitor visibility, how do you monitor some of these effects? And I believe we could go on and on because all the scientists, at least to my knowledge, have expressed some concern about how they do monitor and how they can relate some of this to what is happening in the actual environment.

The thing that recently happened that I was at least involved in last summer doing an acid rain conference in Gunnison, CO. Two scientists attending the conference, one from New England and one from West Germany, took a casual stroll in the forest near Gothic. And I can attest that it was a casual stroll because I was with them. It was during a late summer afternoon rainstorm. The lightning was all about us. I can assure you that it was as casual as it could be. We tried to get out of there as quickly as possible. But these two scientists observed with that thought there was tree damage due to acid rain.

As a result of that discovery, the Federal Environmental Protection Agency and the State of Colorado followed up on this discovery by retaining a committee of experts headed by Dr. Robert Bruck of North Carolina State University.

The Bruck team traveled to the Gothic area late in the summer of 1984 and did a very extensive study on the condition of the forest. While the team did find damage to the forest had occurred in the area, they attributed it to natural causes, including fungus attack which normally occurs in any natural forest. The report they wrote, entitled "Investigation into the Health of Forests in the Vicinity of Gothic," specifically stated: "The major conclusion is that there is now no evidence to indicate that air pollution is contributing to natural forest processes in the Gothic area."

They went on further to say, "we need comprehensive baseline research and monitoring to assess the link between atmospheric deposition and forest health in the Western United States."

They further stated, if this principle is neglected—the gathering of the scientific data—if that principle is neglected, the scientific community, public decisionmakers, and the public at large may be misled when making important policy decisions about changes to ecosystems.

The last example I might cite for the committee was a recently released World Resources Institute study, and I believe there was a good deal of discussion about that study yesterday. That report was in fact, or at least in my mind, a reasonably well written survey of the literature in the field of acid rain. The report contains no new research; it consists only of a compilation of observations and then extrapolations of what might or could or could potentially occur. It does not indicate that there is a current acid rain impact in the West. Rather, the report does indicate that certain precursors do exist which could lead to reasonable further study.

One of the conclusions of the report suggests that further research be done.

An interesting observation I noted in the WRI report contained emission data which demonstrates that emissions of SO_2 in the West have declined since 1970 to a level which is approximately the same as existed in 1960. The report also projects further SO_2 emissions in the year 2000 to be less than the total that was present in 1950. These WRI reported facts are in conflict with the general presumption that sulfates are increasing and are causing worsening acid rain in the West.

Given some of these examples—and my statement outlines a few others—we feel and are recommending that this subcommittee should take it upon itself to form a commission of experts to sort fact from fiction and to provide guidance, not only for the public at large, but specifically for the Congress.

After having heard many of the statements made today by eminent scientists, I feel more strongly than ever that this committee should pursue that approach. We cannot continue to go forth with this uncertainty. We need to know what is the cause, what are the effects, and what to do to correct them. This uncertainty must be removed before Congress burdens the consuming public with a tremendous cost for additional pollution control without knowing what benefits, if any, will result.

Studies of regional air quality have been under way for many years. Studies of visibility such as VIEW, VISTTA, and SCENES all demonstrate that individual point sources are not the only sources affecting visibility in national parks. Similarly, over a dozen acid rain research programs are being conducted in the West in several locations including the Rocky Mountain National Park and the Sierra Nevada Mountains.

I serve with a group of other Federal agency scientists known as the Western Atmospheric Deposition Task Force. They are compiling as much data and are pursuing as much research as possible into this very complex question. None of the researchers that I know of have insisted that we have in fact an acid rain problem. They say that all of the signs are there, and it may well be something could be predicted and something should be done. I recall earlier today one of the questions was asked, what causes this haze. And it couldn't be answered. I just seem to believe that we ought to know, if something is broken, how do we fix it.

In conclusion, WEST Associates is very concerned with the uncertainty surrounding the issues of visibility and acid precipitation in the West. We are recommending that this subcommittee establish a commission of experts to review credible scientific data that is currently available, to propose research if it is needed, and to analyze the results. This commission would be established by this subcommittee with a charter to report directly to the Congress. We will support this subcommittee in every way possible and any proposed commission to advance the research and resolve these scientific uncertainties.

We also believe strongly that the concept of the polluter pays should apply on a national level, that it is important to recognize regional differences, and that solutions should be based on the least cost for maximum benefit.

I sincerely appreciate your attention in this very late hour and the opportunity to be here. I will answer any questions you may have.

Mr. VENTO. Thank you very much, Mr. Green.

I only wish that this subcommittee could establish a commission that would settle all of these particular problems. If indeed I thought that it would or even had a possibility of doing so, I would warmly embrace such a recommendation. Certainly it is something to be considered, I expect, by the committee and by the chairman, along those lines.

I have some misgivings because I note that it seems that we have tried to do it on a nonpartisan basis, on the interagency task force, getting those that are experts working together in these areas, and try to come forth with comprehensive data. I am sure you were in the room and heard my remarks. I have mixed emotions about the establishment of that, because it seems to prolong the decisionmaking process and making us wait, in essence, until more and more information rolls in.

Of course, I have this fear that we will be examining the bones and carcass of our parks and our resource areas and have a perfect document recording the death of many different types of species of plant and irreparable damage to some of our parks vis-a-vis some of this air pollution. On the other hand, obviously we have to satisfy the tough type of questions that you have asked before we can take action. Of course, that gets to be a debate process in which everyone has their say. I guess in these 2 days of hearings we have had views expressed along a whole host of lines. That is why I am so pleased to give you the opportunity to do that.

I do not intend to go through and try and rebut every single point in your testimony. I do not think that anyone has suggested that point sources in and of themselves—point sources constitute a problem insofar as they contribute. I think that there is a lot of agreement with regard to some of the topics that are raised in essence in your report.

I don't know the particular instance where Dr. Bruck went to this site in the Cascades. In any case, I don't recall his—I don't know whether the death of those plants from fungus infection was a direct result, but seldom does a plant in this instance only have one factor that sort of kicks it over the balance. Once that starts, then indeed a fungus infection, insect infestation, other things can contribute to its demise. So, that's a point.

The other that I have some difficulty with, and I might state it, is the visibility issue. I think in that particular case you suggest, and I don't want to misstate you. But I would disagree with your conclusion along those lines. It seems as though there is an absolute relationship between the particulate size with regard to sulfates, their ability to pick up moisture, to serve indeed as condensation nuclei, which we heard in testimony yesterday, and, insofar as doing so, restrict visibility or the scenic visibility of a major resource.

Now, do you disagree with that, Mr. Green?

Mr. GREEN. No, sir. If you would allow me just a moment, I would like to go back to the first statement. You stated, shall we wait forever before we do anything? And we shouldn't do anything that creates more of a delay.

Let me suggest, you probably heard about the Four Corners Powerplant. That facility was built originally for about $270 million. They have just completed an SO_2 scrubber retrofit for $440 million, which is considerably more than the original cost to build the whole facility.

I think it would be a tragedy if someone found out: Hey, it wasn't the sulfate that was causing difficulty, it was the nitrate. Why didn't you fix the nitrate?

I am not suggesting we wait forever.

Mr. VENTO. I don't know about visibility, but I think nitrates cause other problems.

Mr. GREEN. And we talk about the nitrates. I heard a gentleman today from the Rocky Mountain National Park who said it was the nitrates that was affecting the visibility. That is along the front range. In fact, I live very, very close to the Rocky Mountain National Park.

There are other sources such as the mobile source that probably affects the Rocky Mountain National Park more than anything.

Mr. VENTO. I don't know. It probably does. I think nitrite is gas, so I don't think that is a visibility factor. I think maybe what we got mixed up is our ozone problem with our sulfate problem.

In any case, I think the point is that there is almost an absolute correlation between the problems with sulfates and the visibility issue. I don't think that there is any problem, because they have done monitoring of that. They can find the percentage of those present, even though they may be present in smaller amounts. It is suggested 20 percent of the air pollutant that is present, their effect is much beyond that because of their size and because of their tendency to pick up water molecules.

Mr. GREEN. Sir, the World Resources Institute report said sulfates were decreasing, so therefore we should be moving in the proper direction of improving the visibility. Maybe it's something else beside the sulfates.

Mr. VENTO. I think what they point out—and this, of course, came up yesterday. It gets a little bit confusing, I think, because of the 11 Western States' reduction in terms of sulfates. But that doesn't mean that the absolute reduction exists with regard to international sources, point sources, and/or the fact that there are a lot of other older powerplants in the East or in the Midwest that may not contribute significantly, or other areas in the West that are grandfathered, and they continue to spew out large amounts of these sulfates. In other words, they are not dispersed and, depending on wind patterns and so forth, can cause you some rather significant problems in the Grand Canyon and the Rocky Mountain National Park.

Mr. GREEN. I cannot address other industries other than the one I am familiar with. I know that the most stringent of SO_2 regulations are in the West—Arizona, Nevada, New Mexico, Colorado. There has been probably more retrofitting of pollution control devices in western powerplants than in the eastern powerplants.

I would dispute that someone would say that it is increasing. I believe it is decreasing. I thought that that was what——

Mr. **Vento**. I didn't mean to say it is increasing. I think, if you look at the 11 Western States, it probably has decreased. But that isn't the only source that may be affecting the visibility, for instance, in the Grand Canyon. It is international.

Mr. **Green**. Mr. Chairman, I will not give a professorial dissertation. I will be kind. I think we have to look at the facts, that they are decreasing in total number. We are talking about different chemical constituents. That just points up what I am trying to say. I might dispute what someone else says and vice versa. I am just saying, for goodness' sake, let us find out.

Mr. **Vento**. I think we know a lot about that. I think that is the concern. I think there are plenty of things to argue about and disagree about. I don't know if that is necessarily one of them.

I think the testimony has been useful. It will be made part of the record.

We will consider setting up that blue ribbon Vento commission that will solve all of the problems, and we will be back here next year to act on legislation.

Thank you all for your participation, with special thanks to the Park Service personnel and scientists that have been so patient throughout the hearing. We couldn't have had the type of success with this hearing without your good participation.

The meeting stands adjourned.

[Whereupon, at 5:35 p.m., the subcommittee was adjourned, subject to the call of the Chair.]

APPENDIX I

MONDAY, MAY 20, 1985

ADDITIONAL MATERIAL SUBMITTED FOR THE HEARING RECORD

TESTIMONY OF SENATOR JIM SASSER

BEFORE THE

NATIONAL PARKS SUBCOMMITTEE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

May 20, 1985

Mr. Chairman, and members of the Committee. I appreciate having this opportunity to appear before you today. My testimony includes materials from various sources. A complete listing of which is noted at the conclusion.

Acid rain is a highly complex and diffuse topic. The causes of acid rain have been widely debated and studied. While there is yet to be a consensus cause on this phenomenon, one thing, I think, is certain. We can ill afford to sit idly by and allow the quality of our lives and our environment to succumb to this slow, mysterious, and disintegrative force. Now is the time to effect cooperative solutions.

Acid rain is a national problem. The degradation of forests and streams, whether they be in California, Vermont, or Tennessee, should be of concern to all Americans. A concerted federal, state, and local response is necessary to tackle this problem. Nothing short of an all-out national commitment to address this problem will mitigate its peril.

The debate is ongoing regarding the cause or causes of acid rain. The most common culprits are thought to be sulfur and nitrogen oxides. "According to the Environmental Protection Agency, more than 99 percent of the sulfur oxides and 90% of the nitrogen oxides emitted in the Eastern United

States come from power plants, industry, and automobiles. "(1)

In addition, research indicates that "acid deposition may be caused by various pollutants acting alone or in combination, such as sulfur dioxide, nitrogen oxides, trace metals, and ozone "(2)

Whatever the causes of acid rain, we see the debilitating effects throughout this nation. In particular, the Southern Appalachian region has been identified as an area that is increasingly vulnerable to the slow and steady dangers of acid rain. Visual decline and increased forest mortality rates give us pause for concern.

I am particularly concerned about the impact of acid rain on the Great Smoky Mountains National Park. The Great Smoky Mountains National Park is the most visited park in this nation. Each year, some 8 million visitors cross its borders. The Great Smoky Mountains is an international biosphere reserve, boasting an ecological diversity that is unrivalled anywhere on the continent of Europe. In addition, the Smoky Mountains is a world heritage Park, one of only four world properties so designated.

Mr. Chairman, I am proud of the beauty and accomplishments of the Great Smoky Mountains National Park. For many years now, I have sought wilderness designation for this resource and I expect to continue my efforts in that regard.

By law, the Great Smoky Mountains have been designated as a class I airshed. Presumably, the Great Smoky Mountains National Park should be immune from significant amounts of air quality deterioration. Yet, in fact, the Great Smoky Mountains is presently threatened by that slow and silent danger known as acid rain.

Acid rain in the Smokies poses a number of problems, not the least of which is decreased visibility. Visibility impairment is most noticeable during the tourist intensive summer months and at higher elevations. Clingman's Dome, the highest peak in Tennessee, receives high pollutant concentrations. Clouds that accumulate at Clingman's Dome, and other high elevation peaks, may contribute to increased deposition in the Park. Moisture in such cloud occurrences contain relatively high concentrations of pollutant substances such as sulfuric and nitric acids, heavy metals and ozone. (3)

The acidity of rainfall in the Great Smoky Mountains National Park is 4.3 pH, the same pH as throughout the Tennessee Valley. This is 20 times more acid than so-called "normal" rainfall with a pH of 5.6. Since rainfall in the Smokies is 1.5 times that in the rest of the Tennessee

Valley, the deposition of acids there is probably greater than the rest of the region (4)

"Streams at higher elevations experience an increase in acidity after storms. Approximately 50,000 fish died at the Blakenship trout farm on Raven Fork Creek. The fishkills occurred following rains of one inch or more. An investigation later indicated that rainfall collected near Raven Fork Creek was acidic ranging from pH 4.1 to 4.6 "(5)

The Great Smoky Mountains, while biologically diverse, is also an ecologically fragile resource. Soils in the Park are thin, thus, less capable of buffering acidic concentrations of pollutants. "(6) There is evidence that increased acidity in soils has adversely affected the red spruce. "The red spruce is a long-lived shade tolerant species that is a major component of high elevation forests. "(7) There has been a rapid decline in red spruce growth in the Smokies since 1970. As many as 60 percent of the trees at higher elevations may be affected. Preliminary evidence indicates that species have experienced necrotic lesions on needles and crown damage "(8)

Acid rain in the Smokies poses economic, as well as environmental concerns. The Great Smoky Mountains is the most visited park in the park system. The Smokies, last year, received 175, 433 campers in tents, 158,027 campers in recreational vehicles, and 24,235 organized group campers using campground facilities. Campers in the Smokies spent some $653,385 last year."(9)

Sevier County alone has more than 8,000 tourist related jobs. Each year, Sevier County receives $305 million from the travel trade. The 16 county Tennessee area adjacent to the Park receives $714.1 million in tourist dollars annually "(10)Tennessee can ill afford to lose these revenues to the cumulative degradation caused by acid rain.

The problems posed by acid rain are many; the solutions forthcoming, thus far, have been few.

I am deeply encouraged by the courage and leadership of the Tennessee Valley Authority in combating this growing acid rain problem.

TVA, by its own admission "(11) has been one of this nation's largest emitters of sulfur dioxides. Yet, unlike so many others responsible for similar emissions, TVA has stood up to its responsibility to the region and the nation. TVA is a leader in its efforts to upgrade this nation's environmental quality.

In the past six years, TVA has cut sulfur dioxide emissions by 56 percent from 2.3 million to 1 million tons per year. Particulate emissions have been cut by 100,000 tons or over 90 percent. The total TVA investment to date approaches nearly $1 billon. "(12)

TVA has been a pioneer in emissions control technology. Since the late 1960's, TVA's role in flue gas desulfurization development and in demonstrating the atmospheric fluidized bed combustion technology should be a model for the nation.

Environmental neglect cannot be corrected overnight. Yet, it is incumbent upon us to begin to reverse the damages caused by acid rain. Acid rain will not disappear of its own accord. We must continue to raise the level of our thinking about solutions to the acid rain problems.

Mr. Chairman, I have high hopes of achieving wilderness designation for a significant portion of the Great Smoky Mountains National Park. The Great Smoky Mountains should be wilderness and not an acidic wasteland. Present and future generations of Americans deserve the opportunity to witness firsthand the rare and awesome beauty of the Smokies.

The problem of acid rain looms ominously over the Smokies and the nation. I look forward to working with you and other members of this Committee, and my colleagues in the other body, to put into place an effective acid rain mitigation program.

Thank you.

References

(1) *Acid Rain in the South: Its Impact and Its Threat.* National Clean Air Coalition, June 7, 1984.

(2) *Forest Decline and Atmospheric Pollutants Current Understanding and Research Activities National Acid Preciptation Assessment Program*, March 15, 1985.

(3) *Visibility and other Air Quality Measurements made At the Great Smoky Mountains National Park, 1980-1983*, Tennessee Valley Authority, Office of Natural Resources and Economic Development Air Quality Branch. January 1985.

(4) Ibid

(5) Investigations of the Cause of Fishkills in Fish-Rearing Facilities in Raven Fork Watershed, Tennessee Valley Authority, Division of Air and Water Resources, April 1983.

(6) *See*, TVA Visibility Report

(7) "Acid Deposition and Forest Decline, Environement Sci. Tech. Volume 27, No. 7, 1983.

(8) Ibid

(9) Knoxville News-Sentinel, Feb. 25, 1985

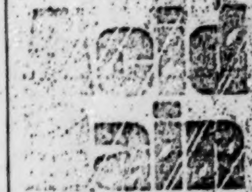
(10) Ibid

(11) Statement of Board of Directors, Tennessee Valley Authority, Before the Committee on Environment and Public Works, United States Senate, February 9, 1984.

(12) Ibid

Pollution a growing concern

Official says research can help save Smokies



Acidic deposits, ozone and a variety of other things are threatening the Great Smoky Mountains National Park. Spruce trees are suffering, some are dying and the death is not from some exotic pest.

Scientists say the problem may be a combination of things — acid rain, ozone, natural causes. Whatever the reason, there is spreading concern for the spruce-fir forest in the national park and there are a variety of studies under way to find out what is happening to the trees and other life in the park.

News-Sentinel staff writer Fred Brown spent a month looking at the issue of acid rain and its many and complex components. His report began yesterday in The News-Sentinel and continues through Wednesday.

Second in a series

by FRED BROWN
News-Sentinel staff writer

A top Tennessee pollution expert says he believes acid rain is one of the top problems facing the Great Smoky Mountains National Park and it's time scientific research was put to use in the park.

Robert Foster, chief of technical services in the state Division of Air Pollution Control, said acid rain has received little attention in the park.

[redacted] rates," Foster said.

The eastern slopes of the Smokies, he said, are a sensitive ecosystem and particularly hard-pressed by acid rain since they do not have the ability to neutralize naturally acid deposition.

"There is another major problem that requires close cooperation with the federal land managers and that is the protection of visibility.

"We haven't developed a visibility protection program in Tennessee," he said.

"But, in terms of protection of park values, I'm of the opinion that acid rain is an area where there is need."

[redacted]

The state Department of Tourist Development said the national park is more than just a crown jewel. It is a treasure chest for a 16-county area adjacent to and near the park's Tennessee boundaries.

[redacted]

More than 8,000 jobs in Sevier County are related to tourism. Travel generates a $50 million payroll in that county and $142 million in the 16 county area.

[redacted]

Some pollution experts believe the next area of conflict coming for the park will be when tourists suddenly discover they are paying for something they aren't getting: such as those breathtaking vistas that have been hampered and viewing time cut back due to haze and ozone pollution.

[redacted]," Foster said.

As for the argument that ozone is a greater problem than acid rain, Foster said ozone has been around for years and he believes the hardier trees have now become acclimated to the stress.

"Ozone is a problem, but it's been a problem for thousands of years. [redacted]

"There is a finite reservoir of alkalinity in the soil. When you deplete that, it leaves you vulnerable to increased damage," he said.

"We can add alkaline to the soil and we can influence soil conditions, but [redacted]

please see TREES, page A8

4.5-8.9 lbs./acre
8.9-13.4 lbs./acre
13.4-18 lbs./acre
18-22.3 lbs./acre
22.3-26.8 lbs./acre
35.7+ lbs./acre
26.8-35.7 lbs./acre

SOURCE: Government of Canada

Solutions becoming complex as pollution problems grow

Last in a series

By FRED BROWN

News-Sentinel staff writer

Worldwide, black holes are [illegible] in forests, streams are [illegible] with acid rain and life is [illegible].

Even the wondrous things man has created, and man himself, are being greatly affected.

Some examples:

■ Centuries-old artifacts and ntiquities are being boiled down y air pollutants; in West Germany, 12th and 13th century tained church glass is falling part.

■ The Black Forest has been hinned out.

■ Thousands of lakes and treams in North America and urope have been acidified by cid rain with extreme damage to quatic life.

■ The New York State Department of Environmental Conservation has found that fish populations are endangered in more han half of all the lakes and onds in the Adirondack Mountains, and more than 200 of the akes and ponds have become totally fishless.

■ In Ontario, 48,000 lakes are hreatened with extinction within years.

■ In Nova Scotia, nine salmon ivers over 500 miles from the earest major group of sulfur ioxide-emission sources no longer have healthy fish.

■ Of the 85,000 lakes in Sweden, 18,000 are acidified.

■ In Norway, more than half e fish population has been eliminated in the last 30 years.

■ West Germany has lost up o 35 percent of its forestlands.

■ The Canadian government as tried everything short of calling off relations with the United States to get America to do something about its sulfur emissions. Canada claims the emissions wander across the border, causing about 60 percent of the problem in Quebec and 75 percent of Ontario's pollution.

■ About 50 percent of pollution in Eastern Canada comes from the United States.

■ About 25 percent of the pollution reaching Vermont is from Canada.

■ Rain that is 10 to 40 times more acidic than normal rainfall has occurred in New England, New York and highly acidic rain has dropped on Florida, Virginia, Texas and North Carolina, in the Northern Plains states of Minnesota and Wisconsin and Colorado. In Raleigh, N.C., there have been rainfalls more acidic than vinegar.

[redacted]

■ Acid rain is inhibiting pollen germination and seed production.

■ Air quality models for the Environmental Protection Agency, seven of the 10 urban areas with the highest rates of lung cancer deaths are in the South: Baltimore, Richmond, Norfolk, Newport News, Mobile, New Orleans and Jacksonville. The cancer rates appear in regions that have high sulfate conditions.

■ Brook trout has disappeared from about 70 percent of its original range, dropping from 425 miles of stream to 125 miles in the Great Smoky Mountains National Park.

■ Acid deposition is responsible for numerous fish kills and death and injury to the shovelnose salamander in the Smokies.

What's going on here?

The National Commission on Air Quality estimates that 70 percent of sulfur deposited in New York and New Jersey each year comes from Illinois, Indiana, Ohio and mid-Atlantic states.

please see SOLUTIONS, page A8

Acid Rain

Acidic deposits, ozone and a variety of other things are threatening the Great Smoky Mountains National Park. Spruce trees are suffering, some are dying and the death is not from some exotic pest.

Scientists say the problem may be a combination of things — acid rain, ozone, natural causes. Whatever the reason, there is spreading concern for the spruce fir forest in the national park and there is a variety of studies in progress to find out what is happening to the trees and other life in the park.

News-Sentinel staff writer Fred Brown spent a month looking at the issue of acid rain and its many and complex components. His four-part series concludes today.

TVA/ONR/WR-83/9

TENNESSEE VALLEY AUTHORITY

INVESTIGATIONS OF THE CAUSE OF FISHKILLS IN FISH-REARING FACILITIES IN RAVEN FORK WATERSHED

Office of
Natural Resources

Division of
Air and Water Resources

EXECUTIVE SUMMARY

An investigation was undertaken to determine the cause of fishkills in trout-rearing facilities located adjacent to Raven Fork Creek within the Cherokee Indian Reservation in North Carolina. Approximately 50,000 rainbow trout were lost at the Blankenship trout farm--a commercial facility--following eight storm events between March 31 and December 2, 1981. In addition, 524 trophy-size trout died in three ponds operated by the Cherokee tribe for stocking reservation streams. It was found fishkills in the trout farm could be prevented by adding lime to water from the creek as it was pumped into the facility; this strengthened the assumption acidity (H^+) was responsible for the fishkills. Mortality of trophy trout was stopped by routing water from nearby springs to the ponds during and following rain events. Because of concern that these fishkills might be caused by acid rain, TVA was requested by the Cherokee tribe to assist in determining the cause. Preliminary surveys of Raven Fork showed hydrogen ion (H^+) and aluminum increased to levels reported to be toxic to trout in the creek following rain events of one inch or more. Rainfall in the area was acidic, ranging from about pH 4.1 to 4.6, with a volume weighted mean of 4.3.[1] Creek water was similar or less acidic following storm events than associated rainwater.

Limited studies were conducted during March through August 1982 to test two hypotheses: (1) Concentrations of H^+ and soluble aluminum in Raven Fork following storm events were high enough to kill rainbow trout and (2) atmospheric deposition was a greater source of stream H^+ than acid-producing geologic formations or the forest soils.

Toxicity tests conducted under conditions simulating those in Raven Fork showed dosages of H^+ and soluble aluminum occurring in Raven Fork following storm events would kill the strain of trout grown on the Blankenship farm. However, limited tests using actual stormflow water did not kill trout. Stream surveys indicate both rainbow trout and macroinvertebrate populations in Raven Fork were reduced compared with nearby Straight Fork which had similar gross habitat features, but did not show large increases in hydrogen ion concentrations ($[H^+]$) following storm events.

Water chemistry studies indicated the dominant sources of H^+ in the creek during storm events were from weak acids (i.e., organic acids and aluminum) and perhaps nitrates of soil origin. Sulfate, the anion of the predominant strong acid of anthropogenic origin, did not appear to contribute significantly to H+ in the stream. Weak acid concentrations in the stream could theoretically control stream H+ to levels measured.

The Raven Fork watershed is dominated by a near-virgin, mature coniferous forest and acidophilic species, such as Rhododendron, which cycle large amounts of aluminum (and are indicative of highly acid soils.) The soils were found to be highly acid (pH 3.7 to 4.1) and very high in exchangeable hydrogen (1200 keq/ha), organic matter (up to 42 percent), and soluble aluminum (up to 2000 mg/l in soil solution). The large amount of exchangeable hydrogen in the soil represents a very large capacity to buffer inputs of H^+ from external sources (such as the atmosphere.) Total annual input of H^+ from the atmosphere of 1.0 to 1.2 keq/ha/yr is minute compared to the buffering capacity of weak acids in the soils which are being replenished annually by leaf fall. Input of H^+ during a rain event was a small fraction of total annual input.

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[1] All samples, June 2 through August 9, 1982.

The chemistry of precipitation changed from domination by anthropogenic strong acids to natural weak acids as it moved through the forest canopy and into the soil. The dominant sources of H^+ in precipitation were sulfuric and nitric acids, strong acids of anthropogenic origin. As precipitation moved through the canopy, sulfate increased slightly, nitrate was reduced by a factor of three, and weak acids doubled. In the soil solution, sulfate remained unchanged, weak acid concentrations increased by a factor of four, and nitrate increased by over 10 fold. Aluminum in both rainfall and water that had passed through the canopy was below detectable levels.

The data for Raven Fork provide strong evidence the forest-soils complex is controlling H^+ and aluminum in the stream following storm events. The creek water reflects the chemistry of soil solution; forest soils were buffered by weak acids against changes in $[H^+]$ resulting from inputs of H^+ from external sources. These results led to the rejection of the hypothesis H^+ deposited from the atmosphere was passing essentially unchanged into the creek. Therefore, an alternate hypothesis--the forest-soils complex in the Raven Fork watershed is the principal source of H^+ and aluminum in the creek following storm events--was tested. Leaching tests were performed on soils from the three dominant forest cover types of Raven Fork watershed using simulated rains of pH 5.7 (geologically pure); 4.1 (two times more H^+ than the ambient average); and 3.2 (15 times more H^+ than the ambient average). Results of these tests showed H^+ and aluminum content of water (leachate) percolated through the soils was dependent on the forest cover type and soil profile and not on the H^+ in the rain. The aluminum content of leachates from some soil profiles was increased by the most acid treatment (pH 3.2) as expected because of the much higher concentrations of both H^+ and anions compared to other treatments.

The leachate studies suggested the soil solution of Raven Fork watershed was toxic to trout. Toxicity tests were performed on rainbow trout using a soil-water extract from a Rhododendron thicket on the watershed. Dilutions of the water extract under conditions simulating stormflow in Raven Fork resulted in mortality ranging from 13 to 58 percent with dosages of H^+ and aluminum within or near the range occurring in Raven Fork.

Results of investigations are consistent with the alternate hypothesis but do not rule out acidic deposition as a contributing factor and may not be applicable to other watersheds. Toxicity tests showed concentrations of H^+ and aluminum occurring in the stream will kill trout. While limited tests with actual storm water did not kill trout, trout in the Blankenship and other trout-rearing facilities are raised at much higher stock densities and are more subject to shock stress initiated by sudden changes in water quality. Fish grown in water low in calcium and sodium, as in Raven Fork, are susceptible to shock stress. Liming probably mitigates fishkills by reducing H^+ of water to a safe level, complexing aluminum to make it less toxic, and adding calcium that prevents shock stress.

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TVA knew plant was killing trees, engineer says

Acidic deposits, ozone and a variety of other things are threatening the Great Smoky Mountains National Park. Spruce trees are suffering, some are dying and the death is not from some exotic pest.

Scientists say the problem may be a combination of things — acid rain, ozone, natural causes. Whatever the reason, there is spreading concern for the spruce-fir forest in the national park and there is a variety of studies in progress to find out what is happening to the trees and other life in the park.

News-Sentinel staff writer Fred Brown spent a month looking at the issue of acid rain and its many and complex components. His four-part report began Sunday and continues through tomorrow.

Third in a series

by FRED BROWN

News-Sentinel staff writer

A former TVA engineer said it was no mystery in the 1950s that sulfur emissions from the coal-fired plant at Kingston was killing sensitive pine trees.

Just about everybody at TVA knew it.

"Why else did they keep making the stacks taller?" said the former employee who asked that his name not be used.

"Sure, they knew the sulfur dioxide emissions were killing the trees. They just kept making these stacks taller to get the stuff up, to get the fumes in the upper atmosphere so that they could be carried and dispersed."

Since the 1950s, TVA has cleaned up its act. So much in fact, it has become a model for other utilities in the nation.

[redacted]

"The TVA recognizes the likelihood of a relationship between the sulfur dioxide and nitrogen oxides in the atmosphere and the atmospheric deposition of acidic or acid-forming compounds in either their dry or wet form," the TVA has written on the subject in its publications about acid rain.

"Although there is little direct evidence of environmental impacts from acid deposition, circumstantial evidence has added to the belief that acid deposition may result in long-term damage to the natural resources in certain areas of the Tennessee Valley, especially those in which soils are poorly buffered to resist added acidity.

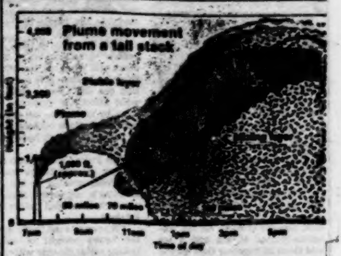
"TVA research has shown the aquatic and forest resources (including soils) of the Southern Blue Ridge Province are the most sensitive of all the Tennessee Valley ecosystems to the potential adverse effects of acid deposition."

Mike Kelly, a TVA acid rain expert, says he believes more research is needed before strin-

please see EMISSIONS, page A8

J. Miles Cary/News-Sentinel

The 1,000-foot chimneys at TVA's Kingston Steam Plant were built in the mid-70s to help remove fly ash and bett disperse sulfur dioxide emmissions.



This example of a plume from the Cumberland Steam Electr Plant in Northeast Tennessee on Aug. 23, 1978, shows how tall smokestack disperses pollutants over a wide area. Horizontal and vertical dispersion is controlled by wind speed, direction and atmospheric stability along the path of the plume. Time of day also affects dispersion.

SOURCE: 1983 Annual Report of the Interagency Task Force on Acid Precipitation

Southern forests in decline

by FRED BROWN

News-Sentinel staff writer

A leading expert in plant pathology at North Carolina State University said he believes the forests of the Southeastern Appalachian chain are in the early stages of a decline that if left unchecked could result in a staggering loss, with similarities to what is happening today in West Germany and the Black Forest.

Dr. Robert Bruck said tree growth in high elevations has slowed since the 1960s and there is a strong correlation between air pollution and that decline.

"The Southeastern forests, in terms of mortality is less than 5 percent," Bruck said. "But in terms of symptoms there are some forests in decline up to 20 percent. That's true particularly of red spruce."

Last year, Dr. Sandy

please see FOREST, page A8

Emissions

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gent emission regulations are put into force nationwide."

Kelly has studied the quality of the precipitation in the Great Smoky Mountains National Park and says it is a general reflection of the air pollution levels within the region.

"There are obviously a lot of dead trees in the park and there is a lot of debate as to why there are dying," he said.

"There's the balsam wooly aphid (killing fraser fir trees). But is that because air pollution weakened the trees? It's a theory, but it's not one supported or refuted at this point."

[redacted]

Oak Ridge is involved in a study to look at the changes occurring across a number of different species of trees in forests in Eastern U.S. to see if these changes can be linked to acid precipitation.

Scientists are aware now that growth rings in spruce and fraser firs are about half of what they were in the 1930s and '40s. That is true for the Smokies as well.

Tim Crawford, project manager for air quality research at TVA's Muscle Shoals, Ala., facility, said not all the blame for the national park's haze and pollution problems can be placed at the feet of TVA.

[redacted] he said.

"But I don't think the sky is falling. I think there has been too much emotionalism about acid rain. What impresses me is if we look at all of the environmental issues of acid rain (health, corrosion, aquatic effects). All are pollution-related effects and if we add them all together then maybe we can come up with a reason to say maybe we should worry about pollution," he said.

"We don't know what is causing the problem up there," said Dr. Herbert Jones, supervisor of TVA's research in the air quality branch of natural resources in Muscle Shoals.

"We are looking at growth of red spruce and fir and I think right now we don't know enough there is a reduction in total growth," he said.

[redacted]

"Our essential position is that there is not enough scientific evidence at this date to warrant sweeping legislative changes that were proposed in Congress to require 50 percent reduction (of sulfur emissions)," said David Spear, company spokesman for Southern.

"That is not to say we don't think that we ought to do nothing. We support the Reagan administration on the subject. The industry will spend about $475 million in the next four to five years and we think there is enough time to determine exactly what the causes are, what the relationships are and the various factors," he said.

He said it has been estimated that a 50 percent reduction in sulfur emissions would cost Southern Co. customers a 25 percent increase in their rates.

Spear said the majority of Southern Co.'s plants are coal fired and use a combination of high- and low-sulfur coal. The company's research arm is exploring how far their emissions are transported.

"While it is not conclusive, it is reasonable to say that some of our emissions probably are carried into the region of the Smokies," Spear said.

"All that relates back to our central question: What does it mean and what are the effects of those emissions. It is our contention we don't know enough on what effect the emissions might have to undertake an expensive control program without a greater certainty it will have the desired effect."

Jim Price, Sierra Club Southeastern representative based in Knoxville, scoffed at the power industry's argument that more research is needed before action is taken.

"It seems to me that's ignoring the heavy weight of evidence linking sulfur dioxide with the decline in the health of the forest and fauna.

"To ignore that would be like putting a patient in intensive care to receive a blood transfusion, but then holding off on the call to the blood bank.

"What we are talking about is the loss of valuable scenic and tourist resource, and a total loss of a natural heritage," Price said.

"We should take heed of this

The tree on the right is experiencing dieback, the tree on the left is healthy

Is the Red Spruce dying?

Average reading from eight plots in the Southern Appalachians in 1984*

Incidence of decline
(Trees showing symptoms of yellowing or browning)

Altitude	East side of mtn.	West side of mtn.
Below 6,000 ft.	16.7%	27.3%
6,000-6,249 ft.	5.4%	9.4%
Above 6,249 ft.	16.7%	37.5%

Incidence of dieback
(Trees dying from the top down)

Altitude	East side of mtn.	West side of mtn.
Below 6,000 ft.	0%	0%
6,000-6,249 ft.	0%	4.7%
Above 6,249 ft.	13.3%	25.0%

*Sample sites: Mt. Rodgers, Va., Grandfather Mountain, N.C., Roan Mountain, Tenn., Mt. Mitchell, N.C., Richland Balsam, N.C., Mt. Guyot, Tenn., Mt. LeConte, Tenn., Clingmans Dome, Tenn.

SOURCE: Study conducted by Dr. Robert Bruck of North Carolina State University for the Environmental Protection Agency

Forest

continued from page one

McLaughlin, an Oak Ridge scientist who has been studying tree damage in the Smokies for the U.S. Environmental Protection Agency, was quoted by The Louisville Courier-Journal that the decline in Smokies was much higher than Bruck's estimate.

are looking at the potential in that watershed, then we have water problems in term contamination and erosion. It can be assessed economically.

"In terms of aesthetics, beautiful spruce tion-related effects and if we dd them all together then maybe e can come up with a reason to y maybe we should worry bout pollution," he said.

"We don't know what is caus-g the problem up there," said r. Herbert Jones, supervisor of VA's research in the air quality ranch of natural resources in uscle Shoals.

"We are looking at growth of d spruce and fir and I think ight now we don't know enough say what is causing the prob-m. There is a reduction of radial rowth, but we don't know if the heavy weight of evidence linking sulfur dioxide with the decline in the health of the forest and fauna.

"To ignore that would be like putting a patient in intensive care to receive a blood transfusion, but then holding off on the call to the blood bank.

"What we are talking about is the loss of valuable scenic and tourist resource, and a total loss of a natural heritage," Price said.

"We should take heed of this warning before we find our very lives, not just the quality of our lives, threatened."

Oak Ridge scientists to study German rain

Seven American scientists, including four from the National eanic and Atmospheric Administration (NOAA) laboratory at ak Ridge, will participate in a onth-long joint American and est German study of acid rain the famed Black Forest.

The Americans leave tomor-ow for Freudenstadt in Baden-Vurttemberg, a small village uthwest of Stuttgart, to join eir colleagues in the experi-ent.

Bob McMillen, a physicist who a member of the American sci-ntific team, said the study is part f ongoing research by the Ger-ans into the problem of acid in, which is devastating West ermany's forests.

"They are faced with a cata-ophic environmental event," cMillen said.

He said the Americans will ok specifically at the amount of lfur dioxide coming into and ing out of Baden-Wurttemberg, German state. The Americans NOAA are considered to be the ading experts on taking these mplicated measurements.

"We will be measuring SO2 in e forest canopy. The Germans ant to know how much (SO2) ds up in the tops of the trees," e said.

McMillen said there will be a riety of other experiments con-cted by the Germans and other European and American scientists during the four-week study.

He said the effort is also part of a scientific exchange on acid deposition and air pollution that has been going on between the two nations since acid rain began to gain more notice in both West Germany and the United States.

McMillen said Baden-Wurttemberg is the most heavily affected state for forest dieback (where the trees die from the top down) near the Black Forest, where 83 percent of the silver fir and 75 percent of the Norway spruce have been affected.

"They are trying to figure out what percentage of SO2 originates in their borders and what comes across international boundaries. They want to see what happens to it when it comes into Baden-Wurttemberg, what happens as it goes out and how much goes to trees and the ground."

The information the American scientists gain in West Germany will be helpful in similar experiments which are planned for Clingmans Dome and other areas in the Great Smoky Mountains National Park.

In addition to McMillen, other NOAA scientists taking part in the study are Detlef Matt, physicist; Jim Womack, physical scientist, and Bruce Hicks, lab director.

Forest

continued from page one

McLaughlin, an Oak Ridge scientist who has been studying tree damage in the Smokies for the U.S. Environmental Protection Agency, was quoted by The Louisville Courier-Journal that the decline in Smokies was much higher than Bruck's estimate.

The newspaper quoted him as saying red spruce growth has been cut by 35 percent during the past decade.

The newspaper said McLaughlin reached that conclusion by drilling core samples and studying the distance between the growth rings.

"McLaughlin has documented a dramatic slowing of growth in the past 25 years for fraser firs, hemlock, shortleaf pine and yellow birch as well as red spruce," the paper said.

McLaughlin would not comment on his research, saying he was involved in a sensitive project and didn't want to do anything that might put it into jeopardy.

The newspaper said his "core drillings have turned up metals and other chemicals that he said probably came from acid rain or other air pollutants — and pollution concentrations were greatest when growth was slowest. That makes air pollution 'one of the strong contenders in the search for causes,' McLaughlin said."

These kinds of findings have caused scientists like Bruck to take a strong stand on the side of action to save the forests while continuing the research.

"I may be wrong here, but I think that in five years we will be as bad off as the West Germans," Bruck said.

Bruck said it is too early to try to come up with conclusions when comparing the U.S. and West German experiences.

"There are two questions. Some are concerned with the economics and what it's going to mean for the industry.

"Our water and yours in Eastern Tennessee is cleansed through the watershed and if you are looking at the potential loss of that watershed, then we would have water problems in terms of contamination and erosion. That can be assessed economically.

[redacted]

"The bottom line is whether we have a similar situation as West Germany. My gut reaction is that it could happen, that we are in the early stages of the phenomenon and that we have more time to study it.

"But how much time?" he asked, leaving his own question unanswered.

[redacted]

He said research is showing is that a likely cause of this high elevation dieback is due to clouds laden with lead.

Bruck said clouds blow across the trees, or settle right on them, in the higher elevations. "We have found that the water in these clouds is 5 to 10 times more polluted than the rain that falls from that cloud.

"By bisecting the cloud, which may be 10,000 feet deep, we've found that when it rains the rain is swirling in the cloud and is being mixed up until it becomes heavy and drops.

"The mountains in Appalachia are at a perfect heighth to intersect the bottom of the clouds. The bottoms of those clouds are 5 to 10 times more polluted than the top of the cloud, because pollution is heavier than water vapor and falls out to the bottom of the cloud."

STATEMENT OF
DR. MOHAMED T. EL-ASHRY AND PROF. JOHN HARTE
BEFORE THE HOUSE SUBCOMMITTEE on
NATIONAL PARKS AND RECREATION
WASHINGTON, D.C., May 20, 1985

Mr. Chairman, and distinguished members of the subcommittee, I am pleased to appear before you to address the critically important topic of air pollution in our national parks. My colleague, Professor John Harte of the University of California at Berkeley, and I appreciate the opportunity to make the following statement.

My name is Mohamed El-Ashry. I hold a Ph.D in Geology from the University of Illinois and I am Senior Associate with the World Resources Institute, a non-profit center for policy research in the areas of natural resource management and environment. Prior to joining WRI, I was Director of Environmental Quality for the Tennessee Valley Authority.

For the record, we are submitting a copy of the World Resources Institute's recent 18-month study of acid rain in the western United States, "The American West's Acid Rain Test," which in several ways relates directly to your hearings today. Dr. Harte and I are co-authors of this study.

Two conclusions from our study merit special consideration by this subcommittee, and I will highlight them briefly for you. We have identified both a vulnerability and an opportunity that we believe deserve special attention.

First, the qualities that make the American West and its vast national parks so valuable to us are precisely the qualities that make them so vulnerable to air pollution in general and acidic deposition in particular.

Second, by recognizing now the relationship between acidic deposition and the sensitive areas in our national parks, we are in a unique position to prevent irreversible damage to these natural treasures before it occurs.

Vulnerability. Our review of existing scientific literature has convinced us that the mountain ranges of the West, which are the dramatic feature of so many national parks in the region, are more susceptible to damage than are the ecosystems in the East. In short, the things that give the West its beauty are what makes it so vulnerable.

For example, mountains are higher and steeper in the West, and they have a thinner soil cover. This means that when acidic deposition falls on these mountains (as rain, snow, fog, or as dry deposits), the acidic runoff can flow into the lakes and streams with little or no neutralization by the soils.

Also, western mountains tend to accumulate more snow than do those in the East, and during the spring melt this can cause a brief "pulse" of acidity to the surrounding bodies of water. This pulse, coming as it does when ecosystems are just beginning to grow with the spring, can place both plant and animal species at risk at a critical time in their development.

The problem of acid "pulses" is further complicated by the fact that many lakes in the West have low alkalinity, the property necessary to neutralize acidic deposition. This is especially true in many lakes in the Washington Cascades, the Sierra Nevadas, and the Rockies.

As you can see on the attached map, ten national parks and one national monument are in areas identified as sensitive to acidic deposition:

- in the Cascade Range, Mount Rainier, North Cascades, and Crater Lake National Parks
- in the Coast Range, Olympic National Park
- in the Sierra Nevadas, Yosemite, Sequoia, and King's Canyon National Parks and Devil's Postpile National Monument
- in the Rockies, Yellowstone, Glacier, and Rocky Mountain National Parks.

Annual average pHs of less than 5.0 have not been observed in any of the national parks in the West. However, pHs between 4.7 and 5.0 (levels approaching those known to have caused damage elsewhere) have been measured at monitoring sites near those parks, notably the North Cascades, Mount Rainier, and Rocky Mountain National Parks. And annual average pHs of less than 5.0 may be occurring unobserved in the parks as well. We do not know for sure. But we know that measurements during the summer months reveal seasonal pH averages of less than 5.0 in some of the parks. Among these are the three mentioned above (North Cascades, Mount Rainier, Rocky Mountain) plus Yosemite and Sequoia. Clearly, adequate monitoring of acidic deposition in these parks is needed to determine the extent to which each is at risk.

In some sensitive areas of the West that are receiving acidic deposition, certain chemical changes have been observed. For example, some streams in the Rockies have been acidifying over the last 15 years and temporary total acidification of a lake at Mexican Cut, Colorado has been observed after spring snow melt. Temporary total acidification of a lake was also observed following a heavy rainstorm in Sequoia National Park.

We believe that decreases in acid-neutralizing capacity are underway in sensitive parts of the West, and biological damage with serious long-term effects is the likely result of such chemical changes. However, let me emphasize that there have been no reports of biological damage from acidic deposition in the West. But this does not mean that damage is not occurring undetected or that it will not happen in the near future. We simply do not know. Neither do we have a way for predicting the time it will take for biological damage from acidic deposition to occur. We can only say that there is evidence that severe damage to forests from air pollutants can emerge rapidly, with little or no warning, as has been the case in the forests of West Germany.

The culprits in acidic deposition in the West, the nitrogen oxides and the sulfur dioxide, are contributed by different sources in the different areas. For example, sulfur deposited on the western slopes of the Rockies comes from the smelters in southern Arizona and the power plants in the Southwest. Nitrogen oxides, on the other hand, come from power plants and from vehicles as far away as Los Angeles. In the Sierras, the nitrogen comes from vehicles in southern California, and the sulfur comes mainly from petroleum production and refining activities.

Mr. Chairman, there is a potential threat to the sensitive areas of the national parks in the western United States. This is a disturbing discovery, but one that need not be entirely negative. By making this discovery now, by identifying the different sources of acidic deposition and the sensitive areas in which they are likely to cause damage, we have a rare opportunity to act in the public interest before serious harm can occur. This brings me to the second point.

Opportunity. It has been rare in the natural history of our country, and rarer still in the few decades that have marked popular environmental awareness, that our people and their policy-makers are in a position to anticipate a serious situation and take steps to correct it before irreversible damage occurs.

Mr. Chairman and distinguished members of this subcommittee, I submit that we have that rare opportunity today: the opportunity in the West to avoid damage similar to that occurring now in the East. We should not wait until crises overtake us, and the solutions become quite expensive. Nitrogen oxides, and to some extent, sulfur dioxide emissions will continue to increase through the end of this century. The possibly irreversible nature of acid-caused damage to water and forest resources requires action now.

While current information justifies concerns about present levels of acidic deposition in the West, some questions require further study and research. To date, identification of all sensitive regions receiving acidic deposition in the West has been limited by the paucity of monitoring sites, particularly at high elevations where ecosystems are most sensitive. In addition, more intensive and comprehensive research on the response of western watersheds to acidic deposition would help to determine future rates of chemical and biological changes in acid-sensitive ecosystems. Further effort is also needed to characterize the biological consequences of multiple pollutants, such as ozone in combination with acidic deposition, on trees.

We have also identified a number of regulatory and public policy actions. Together with the research and monitoring recommendations, they constitute what we believe is a sound beginning for a western acid rain strategy, one that is justified given what we know and what we do not know.

Among the policies and regulatory actions that the WRI report recommends are the following:

- The Environmental Protection Agency should formulate, with key states, comprehensive transportation strategies and regulatory plans to reduce NO_x vehicle emissions
- Congress should not extend beyond its December 1987 expiration date the Non-Ferrous Smelter Order that exempts copper smelters in Arizona from the Clean Air Act requirements
- The United States should negotiate an agreement with Mexico for controlling emissions from Mexican smelters pursuant to the Reagan/de la Madrid agreement of 1983
- State and Federal air-pollution regulatory agencies

should include acidic deposition among the siting criteria for new industrial facilities

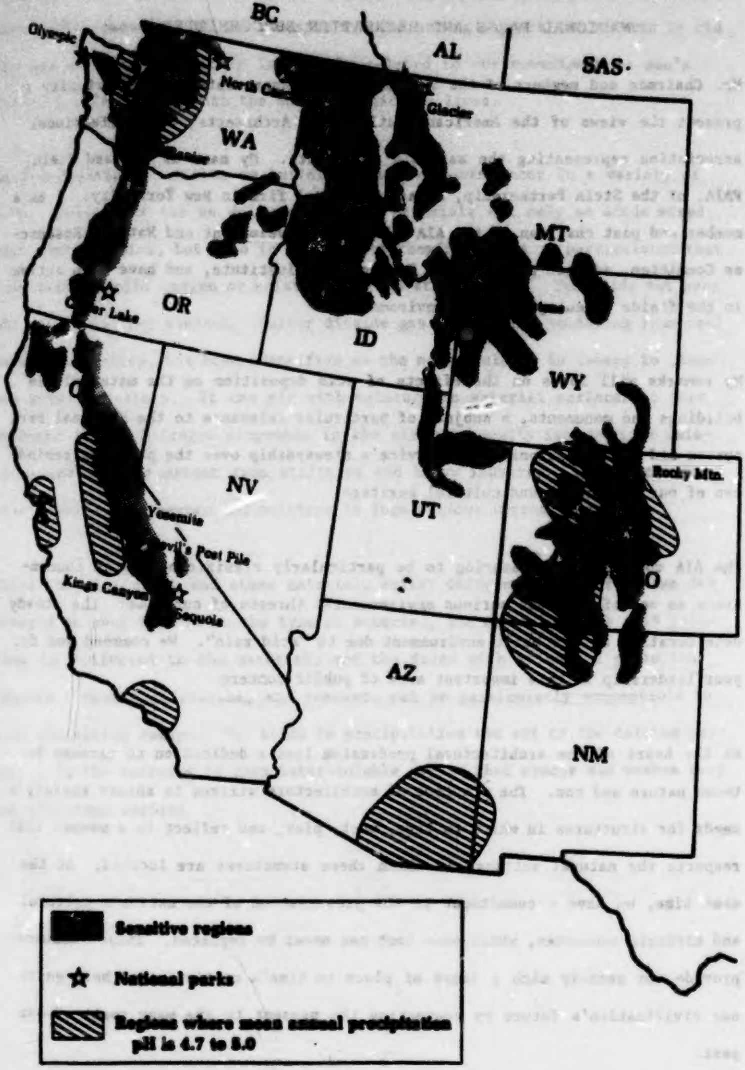
- The Environmental Protection Agency should conduct an assessment of the contributions of major power plants to acidic deposition in sensitive mountain areas, as a basis for proposing control measures
- The U.S. Department of Energy should increase the development and use of energy conservation and renewable energy sources as alternatives to polluting energy sources that contribute to acidic deposition in the West.

Mr. Chairman, we believe that an ounce of prevention is better and cheaper than a pound of cure. These recommendations offer to address the situation in our western states at a fraction of the cost we would have to pay once acidic precipitation damage began. Once the onset of damage occurs, rapid and extensive deterioration could follow. This has certainly been the pattern in the damage to West German forests whereby, in 1982, an estimated 8 percent of the forests were reported as damaged, most likely by a combination of acidic deposition and other air pollutants. A year later, the figure climbed to 34 percent; and by 1984, to 55 percent.

In conclusion, Mr. Chairman, let me commend you for investigating the potential air pollution threats to our precious national parks while there is still time to act rationally and responsibly. Too often, environmental actions by Congress and the Federal government have had to be reactive. Today, we have the opportunity to anticipate the threats to our valuable parklands and resources and act before serious damage occurs.

Thank you.

ACID RAIN IN THE WEST: ...and where it falls
Threatened and Affected Areas


BC
AL
SAS
Olympic
North Cascades
Glacier
WA
Rainier
MT
OR
Crater Lake
ID
WY
NV
UT
Rocky Mtn.
Yosemite
Devil's Post Pile
Kings Canyon
Sequoia
CO
AZ
NM
Sensitive regions
National parks
Regions where mean annual precipitation pH is 4.7 to 5.0

Source: World Resources Institute

STATEMENT OF
RICHARD G. STEIN, FAIA
BEFORE THE
NATIONAL PARKS AND RECREATION SUBCOMMITTEE

Mr. Chairman and members of the Subcommittee, I appreciate this opportunity to present the views of the American Institute of Architects, the professional association representing the nation's architects. My name is Richard Stein, FAIA, of the Stein Partnership, an architectural firm in New York City. I am a member and past chairman of the AIA's Regional Development and Natural Resources Committee, adjunct professor at Cooper Union Institute, and have been active in the fields of energy and the environment.

My remarks will focus on the effects of acid deposition on the materials in buildings and monuments, a subject of particular relevance to the National Park system and to the National Park Service's stewardship over the physical reminders of our historical and cultural heritage.

The AIA considers this hearing to be particularly significant, as it concentrate on one of the most serious environmental threats of our time: the steady deterioration of our built environment due to "acid rain". We commend you for your leadership in this important area of public concern.

At the heart of the architectural profession lies a dedication to harmony between nature and man. The practice of architecture strives to answer society's needs for structures in which to live, work, play, and reflect in a manner that respects the natural settings in which these structures are located. At the same time, we have a commitment to the preservation of the nation's cultural and historic resources, which once lost can never be replaced. These resources provide our society with a sense of place on time's continuum and help guide our civilization's future by connecting the present to the many roots of our past.

Acid deposition abuses both the built and natural environments. As architects we are concerned about the growing body of evidence pointing to the deterioration of the nation's buildings and monuments and their natural settings due to destructive chemicals in the atmosphere. Our strong support for efforts to rid the air of these chemicals is closely related to our commitment to man's friendly relationship with the world in which he lives.

Acid deposition's effects on buildings and monuments occur in a variety of ways. Pollutants can be delivered to the materials not only as acids mixed with precipitation, but also in the form of chemical gases or particulates that then combine with oxygen or moisture to form strong acids. The acids eat away the materials they contact. Sulfur dioxide gas in the air, emanating from coal or oil combustion, has been identified as the major culprit in damage to stone and metal materials. It can mix with moisture on material surfaces to form sulfuric acid. Nitrogen compounds in the air come mostly from vehicle emissions and to some extent from utilities and heavy industry. These compounds also combine with oxygen and moisture to form various corrosive acids.

Stone, metals, paint and other materials suffer different kinds of damage depending on such factors as the type of material, the means by which acid pollution is delivered to the material, and the force with which the pollution impacts. Marble, limestone, and concrete can be particularly susceptible to acid deposition damage. The acids in precipitation can act on the calcium carbonate in the material to form water-soluble gypsum that erodes and washes away the structure surface.

Building features protected from direct contact with precipitation can suffer even worse damage from deposition then from acid precipitation. For example, instead of washing away, the gypsum formed on stone crystallizes in the material's pores, creating enormous pressures that ultimately causes spalling. This process also has serious implications for reinforced concrete where the acid deposition causes the steel to rust. The rusting metal expands and the concrete cracks and in turn becomes more vulnerable to weathering. The failure of reinforced concrete was the major factor in the 1967 collapse of the U.S. Highway 35 bridge between Ohio and West Virginia which killed 46 people.

While no precise dollar figures can be placed on the economic consequences of acid deposition, numerous studies have suggested a cost of enormous dimensions. In 1979, the Council on Environmental Quality estimated that materials damage due to acid deposition amounted to $2 billion a year. A European study estimated that a 50 percent reduction in sulfur dioxide could save $1.16 billion a year through avoidance of damage to galvanized steel and other metals. A study conducted in 1970 by R.C. Robbins through Stanford University indicated that 15 percent of the gold and platinum used in the United States at that time for electrical contacts went to mitigate corrosion caused by sulfur dioxide. An examination of air pollution damage to materials in the Boston area in 1983 concluded that sulfur dioxide effects on paint could cost as much as $31 million, while a 1972 study on paint damage nationwide put the cost at $540 million.

The effects on historic structures and monuments can be devastating. Cast bronze on sculptures and monuments reacts strongly to acid pollution, with studies showing that some monuments have lost a third of their surface metal.

Copper flashings on roofs, and at windows and doors can be attacked by acids, permitting water damage to the basic structure. It is believed that acid pollution has had a significant impact on the Statue of Liberty, now undergoing a $100 million restoration. After 2500 years of supporting the Erectheum Porch of the Acropolis, the caryatid figures were moved indoors to protect them from air pollution damage.

Italy recently authorized $200 million over five years to restore ancient monuments in Rome, while West Germany plans to spend $10 million a year for ten years just to preserve medieval stained glass. To protect the Cologne Cathedral in West Germany from air pollution costs $2 million a year. Acid damage to forests retards lumber production raising overall costs for restoration and rehabilitation projects.

The dollar cost is relatively insignificant compared to the aesthetic and cultural deprivation resulting from the effects of acid rain on materials. All across the country, thousands of outdoor sculptures and monuments, and thousands of irreplaceable historic structures, all of which are unique human statements, are undergoing slow but sure destruction from acid pollution. And as they become lost, a part of the national soul and of the national memory goes with them.

From the research that has been conducted, architects can apply important lessons to reduce acid deposition effects. For example, in places subjected to air with heavy concentrations of sulfur and nitrogen oxides, it may be more prudent to design buildings with exterior features that allow water to wash down the surface of buildings. Although this could lead to surface erosion, it may be preferable to overhangs and projections that while protecting from erosion permit the build-up of gypsum crystals that can cause severe spalling. On the other hand, in areas where acid rain, rather than deposition, is the major problem, traditional wall projections may prove to be the best protection against acid pollution damage. Architects can also minimize acid deposition damage by specifying acid-resistant building materials, such as glass, finishes with baked-on enamel, or concrete with low tricalcium aluminate content, and by noting that use of certain materials next to others, such as sandstone next to limestone, makes them more susceptible to acid damage than other materials combinations. An article entitled "When the Rain Comes" appearing in Progressive Architecture for July 1983, described the architect's response to acid rain in particularly clear terms: "What will prevent the acid-related deterioration of buildings? Proper detailing and material selection, careful separation of incompatible materials and setting of masonry units, certainly more frequent washings, and more attention to the watertightness of the building shell."

As we all know, however, the only lasting solution is the reduction of acid pollutants in the atmosphere. We agree that more research is needed to bring about a clearer understanding of how chemicals in acid deposition react with materials, how sulfur and nitrogen compounds spread in the air from their sources, and what particular mitigation techniques will be most effective in dealing with the problem. At the same time, we believe that sufficient data has become available to determine principal chemical culprits and that the time is past for development of a federal plan of action to reduce acid deposition.

The AIA is deeply disappointed that the Congress has bogged down in attempts to deal with acid rain. In the several years since the issue first began to claim public attention, the concern expressed in proposed legislation has not yet been translated into action. We understand the economic, scientific, and political complexity of this issue, and can appreciate that certain approaches may require some heavy costs and burdens. Yet the problem is a national one. Continuing delay in cleaning up known sources of acid rain pollution exacts a national price in both dollars and human terms and ultimately we all become losers.

The AIA is also disappointed in the Administration's failure to support acid rain mitigation, in favor of additional research. Its position appears to contradict the findings and statements of several Executive Branch agencies and commissions. The National Park Service has stated, for example that "In addition to evidence that links damage to forests to emissions of sulfur and nitrogen oxides, there are good indications that historic buildings and outdoor sculpture, the most tangible evidence of our cultural heritage, are deteriorating at an accelerated rate as a result of these emissions."

The Executive Director of the National Acid Precipitation Assessment Program recently told a House Committee that there may never be a perfect scientific answer to help decide whether to impose legislative restrictions on sulfur and nitrogen oxide emissions to control acid deposition, and the Congress must judge when such controls are justified. Yet the Administration approach is, in effect, a search for that scientific answer.

A 1983 report of the White House Office of Science and Technology Policy concluded, "If we must wait until the scientific knowledge is definitive, the accumulated deposition and damaged environment may reach the point of irreversibility."

The Environmental Protection Agency has made numerous statements that support the need for a mitigation program. For example, in 1984, an agency publication stated, "Recent evidence suggests that repeated contact with existing levels of acidic deposition can cause widespread damage to physical structures, metals, and painted surfaces."

As I have indicated, along with action should come more research. Because acid deposition is a complex national problem with multiple effects, it is appropriate that the federal government undertake basic research of acid deposition's impact on the natural and manmade environments. The AIA supports the Administration's request for additional funds for research. We are concerned, however, that research on materials has not received the emphasis it deserves, despite its promise as evidenced by early results from the Research Triangle Park, North Carolina, study site. Of the $85 million requested for FY 1986 for the National Acid Precipitation Assessment Program, research into the effects on materials and cultural resources would receive only $2.1 million, or only 2.5 percent of the funds recommended.

Mr. Chairman, architects see first hand the effects of acid rain on our environment. As designers of the country's commercial and residential projects, and of the rehabilitation and restoration of this nation's monuments and historic and cultural structures, we see the work of our profession slowly deteriorating because of pollution in the very air around us. From that experience, we have developed an awareness of the great need and urgency for the federal government to act to reduce acid pollution. We ask that it be done.

This concludes my testimony, I am happy to answer any questions you may have.

T0110B

ENVIRONMENTAL DEFENSE FUND

Testimony Before the
Subcommittee on National Parks and Recreation
of the Committee on Interior and Insular Affairs
United States House of Representatives

by Charles B. Epstein
of the Environmental Defense Fund, Inc.

May 20, 1985
Longworth Building, Room 1324

My name is Charles Epstein. I am a staff scientist with the Environmental Defense Fund, a private, national, non-profit organization with 50,000 members. I would like to thank the Chairman for providing me with the opportunity to testify at todays hearings on air pollution problems in the Nation's Parks.

I will focus my remarks on the threat of Acid Rain in the Western United States, an issue which we feel has received too little attention, and which is growing in concern. The Parks of the Western states house some of our most sensitive lakes and streams, and preliminary reports suggest that some of these waters may already be suffering effects due to pollution by air-borne sulfuric acid (Harte, 1985; Melack, 1985). Sulfur pollution has reached levels at which aquatic resources of similar sensitivity in Scandinavia have been damaged.

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Furthermore, we have evidence linking depressed visibility in some areas to another form of this same pollutant, namely, fine particulates of sulfate suspended in the air.

There are indications that, due to increasing sulfur dioxide emissions, the magnitude of the sulfur threat to our Parks' scenery and waters will increase in coming years. We must act in advance of substantial damage to the Park ecosystems, to limit the growth of emissions in the region. Furthermore, we must strive to win the cooperation of our Mexican neighbors, whose large smelter sources near our common border can contribute substantially to our air pollution problem.

The western mountain region, between the crests of the Rockies and the Sierra Nevada, contains numerous precious Parks, including Colorado's Rocky Mountain, Wyoming's Yellowstone, Arizona's Grand Canyon, California's Sequoia, as well as several more in these states and in Utah, New Mexico, Montana, Oregon, and Washington. Industrial sulfur dioxide emissions in the intermountain region have exceeded 1.6 million metric tonnes annually, far in excess of emissions due to natural sources (WRI, 1985). Two thirds to three fourths of these emissions result from the operation of non-ferrous metals smelters (Oppenheimer et al, 1985).

The high-elevation lakes and streams of these Parks are, in many cases, extremely sensitive to atmospherically deposited sulfuric acid. They are underlain by granitic bedrock which provides little natural resistance to input acids, and surrounded by thin soils with little or no ability to exchange bases with these input acids (RMAS, 1983). Consequently, acidic deposition can have severe effects on the chemical quality of receiving waters, changing their suitability as habitats for a wide range of organisms and, ultimately, for game fish.

Monitors of sulfate in precipitation (as opposed to dry deposition, which is additional and potentially larger, but difficult to measure) recorded deposition rates in excess of six kilograms/hectare/year, at three Colorado sites in 1981. Moreover, wet sulfate deposition exceeded nine kilograms per hectare/year in 1982 at Mesa Verde, Colorado (NADP, 1981 and 1982). This is of particular note, both because sulfur emissions and precipitation concentrations were generally lower in 1982 than 1981, and because Mesa Verde is the site of a National Park. While these rates are lower than those recorded at sensitive sites affected by acid rain in the eastern U.S., they approach or exceed the level of deposition at which sensitive lakes in Scandinavia suffered episodic and long term losses in their natural ability to resist added acids. Therefore, on the basis of our knowledge of the sensitivity of aquatic resources in the Parks, of current levels of sulfur deposition, and of levels of sulfur deposition at which Scandinavian waters were affected by acid rain, we have every reason for concern about the well being of the sensitive, high elevation lakes of our western Parks.

But the evidence that a problem is imminent is not merely circumstantial. Data from lakes in the San Juan Mountains of Colorado (Turk, 1985) and the Sierra Nevada (Melack, 1985) indicate elevated sulfate concentrations, which in some cases approach values in lakes elsewhere which have experienced acidification. According to the EPA and Department of the Interior sponsored Rocky Mountain Acidification Study (RMAS, 1983), any significant growth in sulfate concentrations in lake water will lead to the acidification of a substantial number of lakes in Rocky Mountain National Park. This is in part because high-elevation lakes are surrounded by watersheds having thin soils, providing little protection against input acids. Sulfuric acid added to these watersheds leads more directly to surface water acidification than in other settings.

An additional air pollution problem resulting from air-borne sulfur compounds is that of reduced visibility. Although nitrates may play a larger role than sulfates in visibility impairment in the Western states on a regional basis (OTA, 1984), a current study has identified smelter and utility sulfur dioxide output as the prime contributor to visibility reductions in National Parks in California, Arizona, Colorado, and Utah (SAI, 1985).

Recent data indicate that sulfur dioxide emissions, originating primarily from non-ferrous metals smelters, are already causing identifiable changes in precipitation chemistry over a broad geographic area (Oppenheimer et al, 1985), and in some instances, changes in lake and stream water chemistry as well. Even more alarming is the prospect for growth in emissions in the coming years. Due to contributions by new coal fired sources of electricity, new synfuels plants, sour gas sweetening plants, and fertilizer plants, regional sulfur dioxide emissions may be expected to increase significantly in coming decades. On top of this, a Mexican copper smelter is scheduled to open this year at Nacozari, and an existing smelter at Cananea is expected to triple its production and its emissions in coming years. As no emissions controls have been planned on either plant, the combined output of these two sources alone could approach half a million metric tonnes sulfur dioxide per year, or nearly a third of U.S. emissions in the region (Yuhnke and Oppenheimer, 1984; WRI, 1985, pp. 25-26).

The time has therefore come to look closely at all existing and new sources of sulfur dioxide in the West. Any initiatives to weaken the Clean Air Act's controls on new pollution sources or postpone the date by which U.S. smelter emissions are brought into compliance must be rejected. Our vigorous efforts to persuade Mexico to install sulfur removal equipment on its northern smelters must continue. Finally, our concern over the threat of sulfur dioxide pollution in the West should not be pursued in exclusion of attention to nitrogen oxides. Regional NO_x emissions have grown significantly in recent years, and can contribute to some of the same kinds of adverse effects on aquatic resources as does sulfur, particularly at upper elevations where biological uptake is slower.

In summary, in the West, high-elevation aquatic resources are extremely sensitive in many areas. Sulfur pollution is already at a level where effects can start to be detected at some sites, and at a level where, in the long term, serious effects were observed at sites of similar sensitivity in Scandinavia. Regional sulfur dioxide emissions are expected to grow, and the increased burden of pollution is expected to both amplify the magnitude of effects observed, and to magnify the number of sites where these impacts occur. The time has come to pay serious new attention to limiting regional growth of sulfur dioxide emissions. Due to smelters' dominant contribution to the regional emissions inventory, this necessarily will involve paying close attention to copper smelter emissions, both in the U.S. and in Mexico.

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STATEMENT OF SUSAN BUFFONE
PROGRAM COORDINATOR
NATIONAL PARKS AND CONSERVATION ASSOCIATION

before

NATIONAL PARKS AND RECREATION SUBCOMMITTEE

MAY 20, 1985

Mr. Chairman and other distinguished Members of the Subcommittee, I am Susan Buffone, Clean Air Program Coordinator for the National Parks and Conservation Association. For 65 years, NPCA has served as a citizens' voice for the national parks. I am also appearing on behalf of the National Clean Air Coalition, a network of thousands of individuals and national, state and local organizations concerned with the environment, health, labor, parks and other resources threatened by air pollution. I appreciate the opportunity to testify before you today.

Our National Parks and other Class I areas are under a state of siege. These once pristine preserves are bombarded on a daily basis with

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unnatural chemicals from the air. From the lichen deserts in the Cuyahoga Valley, to the greying and browning of the traditional blue mist for which the Great Smoky Mountains are named, to the acidification of lakes in Rocky Mountain National Park and the acid fogs in the Santa Monica Mountains, the destruction is underway.

The pristine character which distinguishes these national treasures is being needlessly squandered -- gradually whittled away to mediocrity. The air is being fouled, the acidity is robbing the land and water of its fertility. The Great Smoky Mountains may one day be only smoky.

The damage reports you will hear over these two days are dramatic and cause for great concern. They are, however, an understatement of the problem. We don't really know how bad it is for in all of the 334 units in the National Park System there are only 35 visibility monitors and 24 stations for monitoring acid deposition. These few pieces of information tell a very sad story.

The legislative history for Shenandoah National Park describes the ability to see the Washington Monument from the Skyline Drive. Today, we often have difficulty at times in seeing an unimpaired view from one ridge to the other. The recent findings of acidified lakes in Rocky Mountain National Park tell us that even as Congress debates and ponders an acid rain control program for 31 eastern states the problem has grown beyond this initial limited solution.

As we lose these last frontiers of truly pristine air we are losing the battle. For once gone from our National Parks, really clean air may be gone forever.

Congress acted in 1970 and again in 1977 to establish air quality programs designed to preserve our parks and wilderness areas as pristine air preserves. The value of preserving some areas for their clean air was clearly endorsed by Congress. The Clean Air Act has a very clear message when it comes to national parks and wilderness areas. There shall be very little new pollution. What little new pollution is allowed should be measured against what the air quality must be in order to sustain the resource.

The Clean Air Act has not, however, prevented the destruction of trees in the Great Smoky Mountains, the mudding of the panoramas in the Grand Canyon 100 days a year or the destruction of trout in the Adirondacks and in the high mountain lakes of Colorado. The Act contains regulatory tools which the National Park Service and EPA have been unwilling to use to protect these resources. You can try to hold their feet to the fire to use the existing tools and you can design more specific protection to protect the parks. We think you need to do both.

Mr. Chairman, last summer then Director of the National Park Service Russ Dickenson attended a national symposium on the state of our parks in the West. When asked, Director Dickenson quite boldly stated that "acid rain is the number one threat to the national parks. When one examines the record his alarming diagnosis is easy to understand.

- From Great Smoky Mountains National Park to the Indiana Dunes National Lakeshore on Lake Michigan, our park scientists tell us that fish kills, reductions in tree growth and an upswing in levels of acid rain, ozone and heavy metals are occurring.

- The high mountain lakes in Rocky Mountain National Park are being bombarded with sulfur dioxide plumes which originate in Arizona and New Mexico. Lakes have already acidified in Rocky Mountain National Park. This same process was witnessed in Sweden and in the Eastern United States, where many have lost their ability to recover from these acid shocks.

- Acid rain has caused such damage to the monuments in Gettysburg National Military Park that the National Park Service estimates that it will cost $2 million to repair them.

- In 1980 NPS architectural conservator Edward McManus was checking the Statue of Liberty for possible damage caused by protestors who had climbed the structure. What he found instead was acid rain damage. As a consequence, the nation is now spending millions to repair this significant structure.

- James Hoyte, Secretary of Environmental Affairs for the State of Massachusetts believes that our cultural resources are currently suffering damage and loss of detail that will never be fully restored. A recent restoration project on one monument in Boston Commons cost

$10,000. I am afraid that we can little afford to restore all of these damaged resources.

- In Great Smoky Mountains National Park 80% of the red spruce found at high elevations are in a state of severe decline. At lower elevations, the decline is 40%.

-Ozone damage has occurred at:

Acadia	300 eastern white pine trees showed injury
Shenandoah	Injury to sensitive species occurs on 90% of all plants observed
Great Smoky Mountains	Between 25-30% of eastern white pine trees show injury
Saguaro National Monument	Almost all of the 225 ponderosa pine trees studied showed injury -- some injury observed in oaks and walnuts
Sequoia National Park	36% of the 540 ponderosa pine trees studied show moderate to serve injury. Ozone-like injury symptoms were recently observed on giant sequoia seedlings

Santa Monica Mountains	Lichen desert
Indiana Dunes National Lakeshore	Foliar injury on 16 species of white and jack pines. Lichen desert

One-fifth of the lower 48 National Park System areas are located in the "Golden Circle" of the southwestern United States. Copper smelters located in this same airshed emitted 1.4 million tons of SO_2 in 1981. The 15 copper smelters in the region contribute approximately 10-30% of the total man-made light extinction in the Golden Circle of national parks in southern Utah and northern Arizona.

Robert Jacobsen, Superintendent of Shenandoah National Park, questions "whether the air ought to be allowed to be used as a dumping ground by individual emitters to the detriment of the public."

We can lime a few lakes. We can restore, maybe, a few works of art without damaging their original value. But to stop these widespread pervasive changes in the ecosystem we must take bold and decisive action.

The National Academy of Sciences, in a report released in 1981, determined that a 50% reduction in sulfur dioxide deposition was needed to curb the tide of acid rain damage. President Reagan's own Science Advisory Committee concluded that we must curb sulfur oxide pollution to avoid further acid rain damage. The resources at risk are too important, and the scientific uncertainties too small, they concluded, to justify waiting longer. It is time for the Congress to enact legislation to clean up sources of acid rain.

The National Clean Air Coalition and the National Parks and Conservation Association support a legislative solution which will reduce sulfur dioxide emissions in the 31 eastern states by 12 million tons. To curb acid rain damage in the West, we believe that emissions from smelters must be limited by the national ambient air quality standard and that there should be no extention of their deadline to clean up beyond 1988. Smelters being planned and now operating in Mexico, just south of Arizona and New Mexico, must be required to control their emissions, and a PSD increment for NOx must be established. We support the establishment of an acid rain water quality based test against which to measure new emission levels, a NOx standard for trucks, buses and other diesel engines and a recognition of the unique value of the air quality of some class II federal lands by reclassifying these lands to class I under the Clean Air Act. (List attached)

Congress has recognized the need to keep and preserve our clean air resources. Amendments to the Clean Air Act enacted in 1977 sought to maintain clean air areas free from "significant deterioration" and to "declare as a national goal the prevention of any future and the remedying of any existing visibility impairment." To describe the government's efforts in fulfilling the law's mandate as slow is an act of charity.

The EPA took three years to adopt regulations under the visibility protection section of the law. Then the Agency refused to enforce the law. Not until the National Parks and Conservation Association took EPA to court and won did the Agency take a tiny step toward protecting visibility.

EPA's monitoring program illustrates its timid approach. EPA has proposed to monitor for only one aspect of visibility impairment, "plume impacts;" and to monitor this at only 23 sites in the 158 class I areas. They have proposed no monitors in Florida. For the entire Appalachian chain there will be 1 monitoring station. For the 16 class I areas in the Northern Rockies region there will be one monitor. For the 13 class I areas in the Central Rocky Mountains there will be one monitor. The Cascade Mountain region has 19 class I areas and no monitor is proposed.

Ignorance may be bliss, Mr. Chairman, but this is absurd. We need to know what the visibility is in every class I area. When a major pollution source wants to locate near a class I area we need to know what the existing conditions are before a proper analysis can be made of the potential future impact from a new source.

The visibility program EPA is enforcing only tries to protect against smoke stack plumes. The existing visibility network tell us that overall regional haze is the more major problem. It is the regional haze that is stealing the majesty of our purple mountain. EPA tells us that they have no intention of implementing any program dealing with the problem of regional haze for several more years. You must judge, Mr. Chairman, whether you believe this is a good faith effort to enforce the Clean Air Act.

The original visibility regulations published in 1980 told the Federal Land Manager (i.e. the Secretary of the Interior and the Secretary of Agriculture) to list those views and vistas which are integral to the purpose, significance or the visitors' enjoyment of the national park. This listing helps insure that a decision on a new polluting facility will be made with consideration for all possible consequences. The regulations thus acknowledge that the visual values of the park do not stop at the parks boundaries. Different levels of protection were afforded visibility inside and outside the park. By establishing a list of important views, the Federal Land Manager performs a service to the state. It tells the state agency-- when people come to this park they want to look at this view. If you change that view, people may stop coming here. For states with a keen economic interest in tourism, this is an important piece of information.

The visibility regulations tell the Federal Land Manager to develop the integral vista list by December, 1985. The Department of the Interior published a proposed list in January, 1981 but has done nothing to indicate that it will publish a final list by the end of this year.

In other forums the Department of the Interior has testified against the National Park Protection Act partially because they believed that these problems could be dealt with administratively. Here is the perfect opportunity to help protect the parks air quality in a procedure where they are providing a service to the state decision maker yet the Department seems unwilling to take advantage of this opportunity.

Mr. Chairman, I urge you to encourage and insist that the Department publish an integral vista list.

Adverse Impact Determinations

Mr. Chairman, the Prevention of Significant Deterioration program establishes budgets for the allowable new pollution in clean air areas. For class I, the most pristine areas, the budget is not the limiting factor. The real protection for the area comes through a resource based air quality related values (AQRV's) test. These AQRV's include the flora, fauna, and visibility of the area. The Clean Air Act makes clear that the Federal Land Manager must err on the side of protecting the resource but gives broad discretion to define what constitutes an adverse impact.

The National Park Service has stated that it considers that any effects on resources in class I areas caused by air pollution that:

- diminish the national significance of the area and/or
- impair the structure and functioning of the ecosystem; and/or
- impair the quality of the visitors experience

constitute an unacceptable adverse impact. We believe that this definition is too broad and fails to adequately protect the resource.

The NPS does not have inventories of plant species by park nor does it understand the structure and functioning of the ecosystem. Without an adequate baseline of information, a judgment on effects can not be properly made. We urge that the FLM immediately address these deficiencies in their baseline knowledge and we ask that the FLM be required to provide notice and the opportunity for public comment on "adverse impact" determinations.

Mr. Chairman, we believe that the parks are being seriously threatened but that remedial solutions are available. We must clean up the air in the East through a comprehensive 12 million ton acid rain control program. We must protect the West by cleaning up smelter emissions, cleaning up the urban "brown clouds" of Denver, Phoenix and other western cities, and by insuring that new major polluting facilities built in the West have adequate pollution control equipment. The National Park Service needs more support so that they can survey the flora and fauna and visibility and be in a better position to protect the parks resources from pollution.

TABLE I

NATIONAL PARK LAND RECOMMENDED FOR REDESIGNATION AS CLASS I

	Acreage	Contiguous Agreage Already Class I
ALASKA		
National Parks:		
Denali	2,426,000	1,939,493
Gates of the Arctic	7,052,000	
Glacier Bay	3,878,269	
Katmai	5,330,126	
Kenai Fjords	567,000	
Kobuk Valley	1,710,000	
Lake Clark	2,439,000	
Wrangell-St. Elias	8,147,000	
Total	31,549,395	
National Preserves		
Aniakchak	466,238	
Bering Land Bridge	2,774,182	
Denali*	1,335,380	
Gates of the Arctic*	943,327	
Glacier Bay*	54,948	
Katmai*	410,473	
Lake Clark*	1,405,487	
Noatak	6,557,204	
Wrangell-St. Elias*	4,872,953	
Yukon Charley Rivers	2,516,821	
Total	21,337,013	

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* Lands contiguous to the national park.

	Acreage	Contiguous Agreage Already Class I
CALIFORNIA		
National Parks:		
Channel Islands	249,354	109,027
Redwood	48,000	403,023
Sequoia	16,000	
Total	313,554	
NEW MEXICO		
National Parks:		
Chaco Canyon	33,989	
OREGON		
National Parks:		
Crater Lake	24,000	160,290
TEXAS		
National Parks:		
Big Bend	21,250	708,118
FLORIDA		
National Parks:		
Biscayne	174,643	

TABLE II

CLASS II AREAS RECOMMENDED BY THE DEPARTMENT OF INTERIOR FOR REDESIGNATION TO CLASS I

State-Type	Acreage	Federal Wilderness Areas Already Designated Class I
ARIZONA		
Chiricahua NM*	10,648	9,400
Canyon de Chelly NM	83,840	--
Organ Pipe Cactus NM	330,689	312,600
Saguaro NM	83,578	71,400
Sunset Crater NM	3,040	--
Wupatki NM	35,253	--
Paiute Primitive Area	35,092	--
Paria Canyon Primitive Area	27,515	--
CALIFORNIA		
Death Valley NM	2,067,795	--
Joshua Tree NM	559,960	429,690
Lava Beds NM	46,821	28,460
Muir Wood NM	554	--
Pinnacles NM	16,216	12,952
Chemise Mountain Primitive Area	3,941	--
COLORADO		
Black Canyon of the Gunnison NM	13,672	11,180
Colorado NM	20,445	--
Dinosaur NM	211,053	--
Great Sand Dunes NM	36,827	33,450
Powder Horn Primitive Area	40,400	--
FLORIDA		
Big Cypress National Preserve	570,000	--
Fort Jefferson NM	47,125	--
IDAHO		
Craters of the Moon NM	53,545	43,243

* NM = National Monument

STATEMENT OF DR. JAMES N. GALLOWAY

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May 20, 1985

Prepared for Public Hearings by the House of Representative

Subcommittee on National Parks and Recreation

Room 1324 Longworth House Office Building

Washington, D.C.

I. INTRODUCTION

I am James Galloway, Associate Professor of Environmental Sciences at the University of Virginia. I have spent the past eleven years investigating the causes and effects of acid deposition. During that period, I have published over fifty papers, served on Committees for the National Academy of Sciences and created three major research programs. Today, I'll address the phenomena and effects of acid deposition in North America and its National Parks, with special reference to Shenandoah National Park, Virginia.

II. ACID DEPOSITION IN NORTH AMERICA

Acid deposition is caused by combustion of fossil fuels--coal, fuel oil, gasoline, etc. When the fuel is burned, sulfur and nitrogen in the fuel, and nitrogen in the atmosphere are converted to sulfur dioxide and nitrogen oxide. Being gases, these are emitted to the atmosphere where they are converted to sulfuric and nitric acids. These acids are then removed from the atmosphere by wet and dry deposition--making the atmosphere less acidic but the deposition more so. Currently, sulfuric acid is about twice as important as nitric acid, on an annual basis, in contributing to acid deposition.

Acid deposition affects a large portion of eastern North America. Figure 1 shows the degree of enrichment of sulfate (from sulfuric acid) in North American precipitation relative to remote areas of the world. Clearly, precipitation in eastern North America has 8-16 times more sulfate than in remote areas. Similar enrichments are noted for nitrate and hydrogen ion.

While the impacts of acid deposition are many, of special concern are those on streams and lakes, for once they are acidified to below pH 5.5 - 6, substantial decreases in biological populations will occur. For a stream or lake to be acidified by acid deposition to that degree, these criteria must be met.

1. The stream or lake and its watershed must receive acid deposition.

2. The watershed of the stream or lake must be such that the acids can pass through the soils. If they cannot then the stream or lake will not be acidified.

3. The stream or lake must be sensitive. That is, it must have a low enough alkalinity such that acidification by acid deposition will lower the pH to a range where biological effects will occur.

These criteria are not met in all areas of North America. Figure 2 gives a summary of how National Pakrs in three regions (western, northeastern, and southeastern United States) meet these criteria. The following discussion expands on this figure.

Northeast

National parks in the northeastern United States receive very acidic deposition. Many streams and lakes are quite sensitive and their soils don't offer protection from the acids. Streams and lakes in the northeast have been documented to be acidified on a regional scale by acid deposition with the resulting biological effects.

West

National parks in the western United States do not receive substantial amounts of acidic deposition. However, they do contain sensitive streams and lakes and have soils that will not protect streams and lakes from acidification. Therefore, if acid deposition were to increase in the West, there would be a problem.

Southeast

National parks in the southeastern United States receive deposition as acid as in the northeastern United States and have streams and lakes as sensitive as the northeastern United States. However, regional scale acidification has not been observed in the southeast.

Why? It's because the soils in the southeast do not release the acid deposition to the sensitive streams and lakes. Specifically, by the process of sulfate adsorption, the soils retain the atmospheric sulfate (and its associated acidity) and prevent most of the acid from entering the streams and lakes. In other words, the soils act as a barrier to acid deposition. That is the good news; the bad news is that this barrier can be pvercome, the adsorption capacity can be filled. Therefore, eventually the acids will be released to the streams and lakes. We at the University of Virginia estimate that this will occur in many mountainous streams of the southeastern United States in one to three decades.

The differences in response to acid deposition between northeastern and southeastern streams and lakes is further explained in Figure 3, which shows why sensitive northeastern streams and lakes have already been acidified and why sensitive southeastern streams and lakes will become acidified in the future.

In Figure 3, soils (solid-line boxes) in the northeast and southeast receive identical amounts of acid deposition (dotted arrows). The sulfate adsorption capacity in the northeastern soils is smaller than the southeastern soils, as shown by the relative sizes of the sulfate reservoir (dashed-lined box). Currently in the northeast, the sulfate reservoir is filled, thus the rate of sulfur deposition to soils is the same as the rate of release to the streams or lakes. This is graphically depicted by having the horizontal arrow (release to streams) the same width as the dotted arrow (deposition from atmosphere). Conversely, in the southeast, since the soil sulfate adsorption capacity is larger and not filled, most of the atmospheric sulfur deposition is retained in the soil and only a fraction gets into the lake, as shown by the thinness of the arrow leaving the southeastern soil box. However, five to ten years later, while the northeast situation has not changed (arrows still equal width) the soils in the southeast have changed. Their sulfur reservoirs have begun to be filled and thus more sulfur and its associated acidity is released to the streams and lakes. Therefore, over this time period, streams and lakes in the southeast will become more acid but those in the northeast will remain about the same given no changes in sulfur deposition. Ten to thirty years later, the sulfate adsorption capacity of the southeastern soils has filled and lakes and streams are being acidified at a much faster rate. Again, there are no changes in the streams and lakes from the northeast.

In summary, There are three main points of this regional comparison.

1. In the northeast, streams and lakes have already been acidified on a regional basis by acid deposition.

2. In the west, streams and lakes will be acidified on a regional basis only if acid deposition increases.

3. In the southeast, streams and lakes will be acidified on a regional basis as the sulfate adsorption capacity of the soils is filled. This will require no increase in acid deposition.

In other words, on a regional basis, stream and lake acidification has occurred in the northeast, may occur in the west and will definitely occur in the southeast.

III. SHENANDOAH NATIONAL PARK

This section presents the implications of the above on impacts in

Shenandoah National Park. My colleagues (Dr. George Hornberger and Dr. Jack Cosby) and I at the University of Virginia have been investigating the phenomena and effects of acid deposition on the streams and soils of the Shenandoah National Park for the past 5 years. Our project, the Shenandoah Watershed Study (SWAS) has received funding from the National Park Service, National Science Foundation, Environmental Protection Agency and the Geological Survey. As part of our research we have surveyed stream sensitivity, measured acid deposition and acid cloud water, determined the degree of stream and soil acidification, and estimated future impacts on the Park due to acid deposition. We are beginning research projects on dry deposition, the impact of cloud water deposition on streams and forests, and changes in forest growth due to acid deposition and other pollutants. A bibliography of our research reports is attached (Appendix I).

The remainder of this testimony briefly summarizes our results by asking and answering a series of questions.

1. Does Shenandoah National Park receive acid deposition? The Park receives increased amounts of sulfuric acid from the atmosphere. The magnitude of this increase is shown in Figure 4 which compares precipitation composition in the Park to remote areas of the world. These data show that the concentrations of sulfate and nitrate (part of sulfuric and nitric acid) in precipitation in the Park are 12 and 14 times greater, respectively, than in remote parts of the world. This represents a major perturbation of the Park environment.

2. Are streams in Shenandoah National Park sensitive to acidification by acid deposition? A synoptic survey of the Park has shown that about 50% of the streams are sensitive enough to acid deposition such that acidification would result in biological effects (Figure 5).

3. Are streams in Shenandoah National Park being acidified by acid deposition? It is our belief that streams in the Park have experienced some acidification and will definitely experience a larger degree of acidification in the next few decades.

4. Why will streams in Shenandoah National Park continue to acidify? As discussed in the previous section, soils in the southeastern United States have a large capacity to retain sulfur from atmospheric deposition. Soils in Shenandoah National Park are exactly the same. They have been receiving increased deposition of atmospheric sulfur for the last 100 years, and they are currently 20-60% saturated with sulfur. This 100 years of atmospheric deposition of sulfur has been primarily stored in the soils as opposed to being released to the streams and causing acidification. However, our results show that within the next few decades, if sulfur deposition remains the same, the sulfate adsorption capacity will be filled and thus the sulfate and its associated acidity will likely be released to the streams, resulting in regional scale stream acidification.

5. At what rate will streams acidify in Shenandoah National Park? We have made estimates of past and future rates of stream acidification using a model that is based on our research and the research of other groups around the world. An example of our predictions is shown in Figure 6 for White Oak Run (WOR), a stream located in the southwestern part of Shenandoah National Park (Figure 5) in Shenandoah National Park.

Figure 6 shows the response of the pH of WOR to changes in the pH of precipitation. There are three time periods presented, a pre-acid deposition period from 1864 to 1884, an acid deposition period from 1884 to 2004 and a post-acid deposition period beginning in 2004. As is evident from the changes in the pH in precipitation in Figure 6, this example has acid deposition being turned on in 1884 and turned off in 2004. To the best of our knowledge, the pH of WOR before acid deposition began was about pH 6.3. During the 100 year period since the onset of acid deposition, we estimate that the pH of WOR has dropped a significant amount.

The model shows that for the next 20 years, until the pH of acid deposition increases (2004), stream pH will continue to decrease as the soil sulfate adsorption reservoir fills.

When the pH of precipitation is returned to pre-acid deposition levels (2004) the pH of WOR begins to increase, but again slowly. Just as it took some time for the soils to fill up with sulfate, thus it also takes time for them to lose the sulfate from the adsorption reservoir.

Thus, this example of the past and future response of a stream in Shenandoah National Park to acid deposition shows that acidification has occurred in the past and will continue to occur in the future.

It needs to be emphasized that Figure 6 is a result of a model which reflects our current understanding of how soils and streams respond to acid deposition. As such, it is imperfect. However, we feel confident that the general behavior illustrated in this example is correct and that acidification of streams in Shenandoah National Park (1) has already occurred, (2) will continue to occur in the future and (3) that recovery, if acid deposition is reduced, will be slow.

IV. WHAT NEEDS TO BE DONE?

Research on the impacts of acid deposition on national parks in general and Shenandoah National Park in particular needs to be focused in the following areas.

1. As part of the National Acid Precipitation Assessment Program, the National Park Service is studying four national parks, three in the

west where deposition is not very acidic and one in the Midwest that doesn't have sensitive streams. The National Park Service should expand this program to include parks in the northeastern United States where stream and lake acidification has occurred and to parks in the southeastern United States where acidification will certainly occur.

2. The time scales of stream acidification in Shenandoah National Park need to be determined. Specifically, what will be the rates of acidification for streams in Shenandoah National Park? How long before biological changes are observed? What will these biological changes be? What are the implications for the park's resources? How will they effect recreation in the park?

3. A program on the effects of acid deposition on forests in Shenandoah National Park is needed. Specifically, what is the interrelationship between acid deposition, ozone, drought and insects on possible decreases in forest growth in the Park? When will these changes be evident? What will be their magnitude? What will be their impact on resources?

These programs can only be successful if an integrated research approach is adopted to addressing the impacts of acid deposition and related air quality issues on the ecosystems and other resources of Shenandoah National Park. We know detrimental changes are going to be occurring at a faster rate in southeastern parks; it is our responsibility to determine their magnitudes, impacts and possible solutions.

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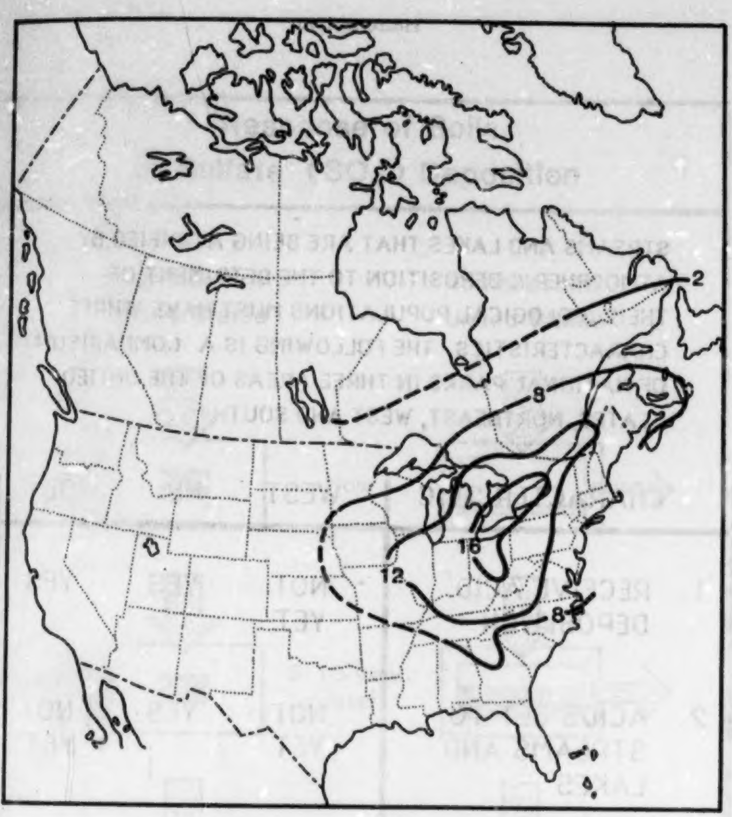


Enrichment factors for sulfate concentration in North American precipitation in 1980 relative to remote areas

Figure 1

Figure 2

STREAMS AND LAKES THAT ARE BEING ACIDIFIED BY ATMOSPHERIC DEPOSITION TO THE DETRIMENT OF THEIR BIOLOGICAL POPULATIONS MUST HAVE THREE CHARACTERISTICS. THE FOLLOWING IS A COMPARISON OF NATIONAL PARKS IN THREE AREAS OF THE UNITED STATES, NORTHEAST, WEST AND SOUTH:

CHARACTERISTIC	WEST	NE	SE
1. RECEIVE ACID DEPOSITION	NOT YET	YES	YES
2. ACIDS GET TO STREAMS AND LAKES	NOT YET	YES	NOT YET
3. STREAMS AND LAKES SENSITIVE TO ACIDS	YES	YES	YES

Figure 3

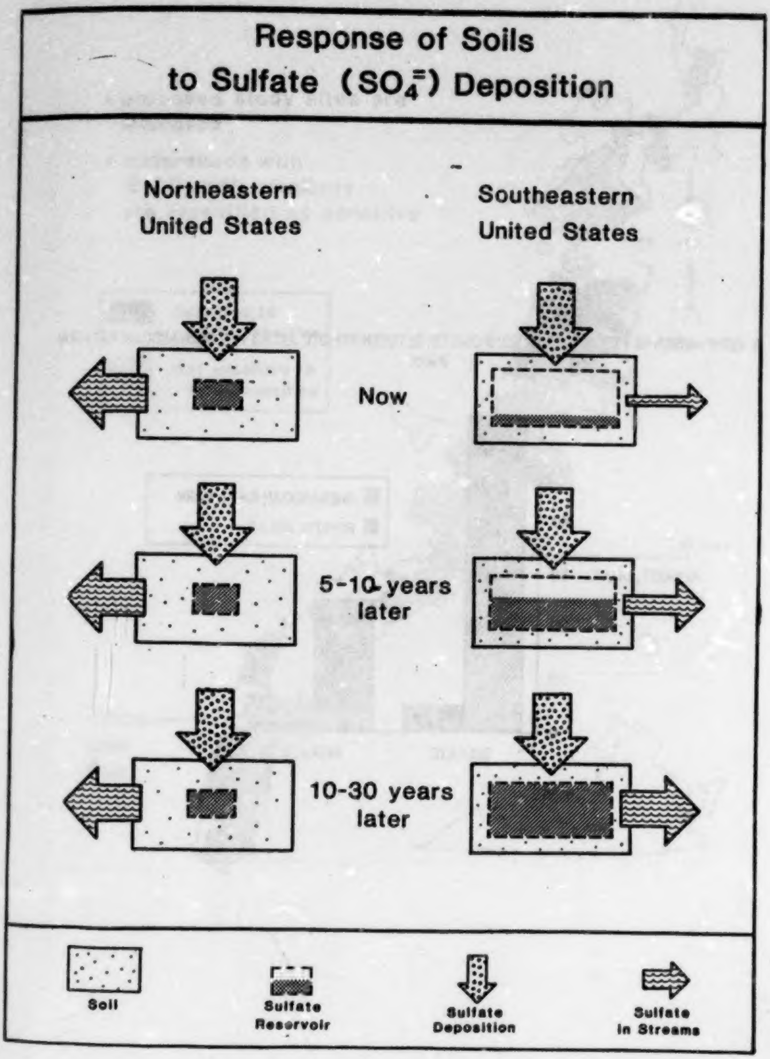
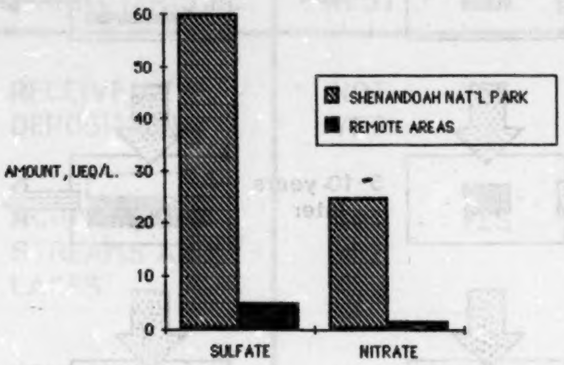

Response of Soils
to Sulfate ($SO_4^{=}$) Deposition
Northeastern
United States
Southeastern
United States
Now
5-10 years
later
10-30 years
later
Soil
Sulfate
Reservoir
Sulfate
Deposition
Sulfate
in Streams

Figure 4

A COMPARISON OF PRECIPITATION COMPOSITION BETWEEN REMOTE AREAS AND SHENANDOAH NATIONAL PARK



Sensitivity of Streams in Shenandoah National Park to Acidification

- proposed study sites are indicated
- watersheds with ≤100 $\mu eq/l$ alkalinity are classified as sensitive

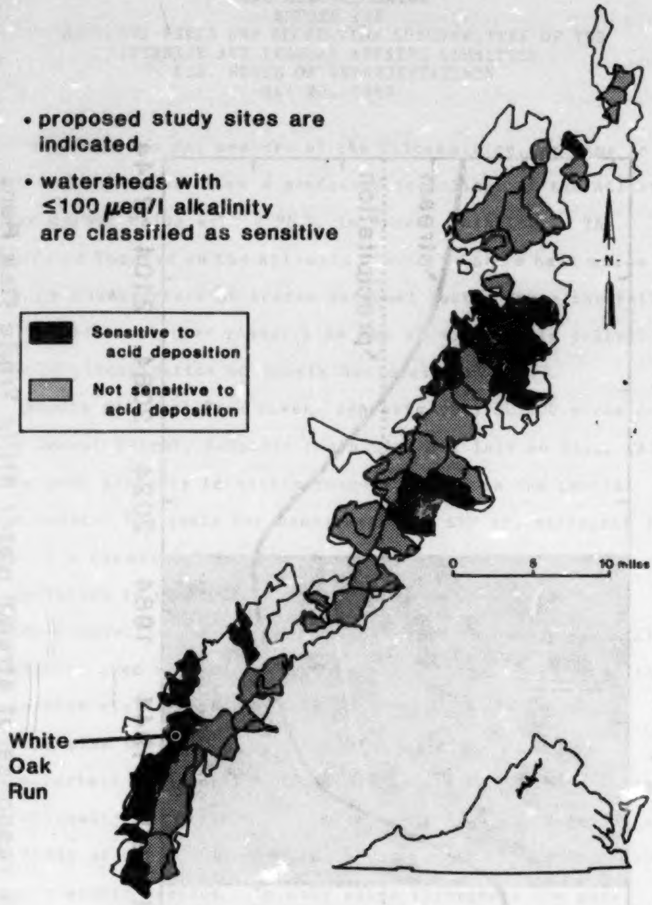
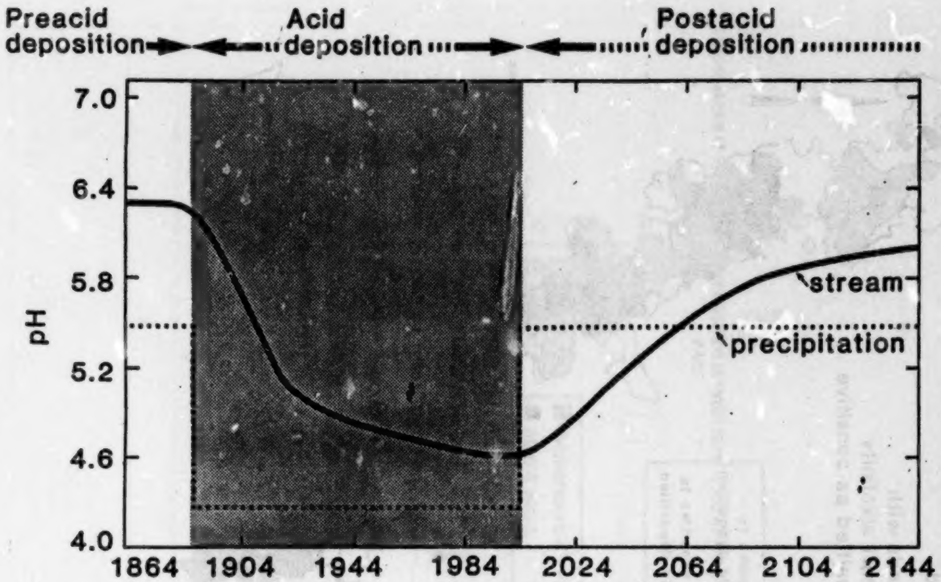

■ Sensitive to acid deposition
▨ Not sensitive to acid deposition
N
0
5
10 miles
White Oak Run

Figure 6



The response of stream water pH in White Oak Run, Shenandoah National Park to changes in the precipitation pH.

TESTIMONY OF
DR. JANET LEE ANDERSEN
PROFESSOR OF BOTANY, COLLEGE OF THE ATLANTIC
BAR HARBOR, MAINE
BEFORE THE
NATIONAL PARKS AND RECREATION SUBCOMMITTEE OF THE
INTERIOR AND INSULAR AFFAIRS COMMITTEE
U.S. HOUSE OF REPRESENTATIVES
MAY 20, 1985

Mr. Chairman and members of the Subcommittee, my name is Janet Lee Andersen. I am a professor at College of the Atlantic in Bar Harbor, Maine with a Ph.D. in Forest Pathology. The College is located on the Atlantic Ocean two and a half miles from the headquarters of Acadia National Park. Since the fall of 1981, I have conducted research on the effects of air pollution and acid precipitation on Acadia National Park (ANP).

Acadia National Park covers approximately 30,000 acres on Mount Desert Island, Schoodic Peninsula, and Isle au Haut. All of the park property is within Hancock County on the central Maine coast. The goals for management for ANP are different from those of a commercial forest. Lower timber productivity due to air pollution is of little concern compared with shifts in species composition that might reduce the richness of the visitor experience. Even more obvious to visitors is looking out at the spectacular vistas through a bluish or brown haze or seeing browning pine trees along the roads and trails.

A variety of natural habitats occur within ANP supporting a wide diversity of species. Mount Desert Island is the nothernmost limit of many temperate plants and the southernmost limit for some arctic species. In many sites throughout the park, soils are thin and patchy and there are steep slopes with exposed bedrock. The granitic bedrock which dominates on Mount Desert Island has poor acid buffering capacity. However, at lower elevation (below 40 meters) glacio-marine sediments found in some stream beds and soils increase the acid buffering capacity for these watersheds. The alkalinity (measurement of the buffering capacity) of surface waters in ANP is low (<100 ueq/l) and is an indication that these waters are vulnerable to acidic deposition. ANP is frequently enveloped in fog and receives close to 50 inches of rainfall annually. At the National Atmospheric Deposition Program (NADP) monitoring site at ANP, an annual volume-weighted pH value of 4.3 to 4.4 has been recorded each year since monitoring began in 1980. This means that ANP is receiving acid deposition with some rainfall having a higher pH (less acid) and some rainfall having a lower pH than the annual average.

There is relatively little industry on Mount Desert Island, but there are some major sources of sulfur dioxide and other pollutant within 100 km of ANP. The four million tourists which visit ANP every year contribute to levels of lead and other pollutants associated with gasoline consumption. In addition, long distance transport of pollutants such as ozone are impacting park resources.

Air Pollution and Acid Deposition Monitoring Projects

Several pollution monitoring projects are conducted on Mount Desert Island. The park personnel conduct visibility studies by photographing the view from the highest mountain on the island

(Cadillac, elevation 1530 feet) three times a day. Sulfur dioxide levels are not currently monitored, but at the park headquarters, ozone is monitored continuously and recorded every hour. Rainfall amounts and wet deposition are measured weekly as part of the NADP. After field tests are conducted for pH and conductivity, the sample is sent to a central laboratory for analysis of pH, conductivity, sodium, potassium, magnesium, calcium, chloride, ammonium, nitrate, and sulfate. Since October, 1984 the park has switched from monitoring dry deposition for the NADP and is now part of a Maine State program that measures total suspended particulates, sulfate, and inhaleable particulates (fine particle fraction). These dry deposition tests are conducted by park personnel every six days and analysis is conducted by the Maine Department of Environmental Protection.

The NADP equipment does not detect fog water which may be a significant portion of the moisture reaching vegetation in ANP. In the summer of 1984, Dr. Donald Cass also of the College of the Atlantic faculty and I joined with researchers across North America from Puerto Rico to Alaska to monitor cloud and fog water at eleven different sites. Our monitor at College of the Atlantic operated in 1984 from June 8th to November 30th. It is taken down to prevent ice and snow from damaging the equipment. We anticipate this monitor to be operational by the first of June this year.

Surveys of Impacts of Pollution on ANP

In addition to the monitoring projects, there have been several surveys made to evaluate the impact of air pollution and acid precipitation on resources of ANP. Mary Foley, Research Forest Ecologist from the North Atlantic Regional Office of the National Park Service has been conducting the field work for the FORAST Project at ANP. This is a regional project for the eastern United States designed to quantify the effects of acid deposition and air pollution on the growth of eastern forest trees by using tree ring analysis to evaluate historic growth patterns.

In October, 1982, I began a cooperative project with two geologists from the University of Maine that included a two year comprehensive study of the current status of the surface waters of ANP and an analysis of sediment cores from three ANP lakes for inferred historic trends of precipitation pH. The 18 lakes and ponds, and 23 first- and second-order streams included in this project were sampled during all seasons, especially during spring snow-melt. Chemical analysis of water samples included pH, conductivity, alkalinity, color, and determination of the concentrations of calcium, magnesium, potassium, sodium, iron, zinc, manganese, aluminum, sulfate, nitrate, and chlorine.

In 1983 and 1984, Dr. Clifford Wetmore and Thomas Sullivan conducted a survey of the lichen flora of ANP. Included in their study was an analysis of lichen specimens for sulfur content to estimate if current sulfur dioxide levels were high enough to be causing physiological injury to sensitive lichen species where no visible injury could be observed.

Effects of ozone on park resources were surveyed in 1984 by Dr. Michael Treshow. His efforts concentrated on eastern white pine (Pinus strobus) as this species is one of the most susceptible to ozone injury. Mary Foley (NPS) and I will be conducting a follow-up study this spring and summer. We will monitor 45 pines every two weeks in an attempt to correlate ozone events with injury (chlorosis and necrosis) on needles of eastern white pine.

Results of Monitoring and Survey Projects in ANP

ANP is receiving precipitation which on an annual volume-weighted basis has a pH of 4.3 and 4.4. Weekly collections have been as low as 3.2; single rain events are not monitored at NADP stations. The pH values recorded at ANP are close to or lower than the pH values recorded at the three inland Maine NADP sites. As coastal sites receive more rainfall than inland sites, it would be expected that pH values would be higher at ANP than at the inland sites. As this is not the case, ANP may actually be receiving more acid particles than inland Maine sites.

Fog water samples collected in the summer of 1984 averaged two to three times more acidic than rain water samples collected for the same event. This means that the pH of fog moisture is not being buffered by marine aerosols. The exception to more acidic fog water occurred on August 13th when a low level fog bank coming in from the relatively unpolluted northeast enveloped the island (pH 5.32) while a high elevation rain storm came across the island from the southwest (pH 4.14). The rainfall was more than 16 times as acidic as the fog bank coming in from the northeast. However, a week earlier on August 7th, we recorded a fog event with a pH of 2.90 and elevated sulfate and nitrate concentrations. That same day ozone levels exceeded the Maine State Standard for 6 hours. The polluted air mass moved southwest and over the next few days was detected in New Hampshire, New York, and as far south as Virginia with cloud/fog water pH values ranging from 2.80 to 3.09. Another acidic fog event was detected on November 27th. The pH of this sample was 2.42 (three times more acidic than the August collection) and the sample was actually gray in color. Unfortunately other monitoring stations has already taken down their equipment for winter so we don't know the full extent of this event. Further analysis is still underway on this sample, but it should be noted that while ozone levels were not elevated during this period, the suspended particulates level was higher than any collection since September 9th and the sulfate particulates level was higher than any time since August 16th.

The importance of acid deposition to ANP depends on whether there is a negative impact to park resources. Here scientists, myself included, become cautious. Spring rainstorms may be responsible for small pools where salamanders and other amphibians might breed. Precipitation pH levels are low enough to effect breeding success of spotted salamander (Ambystoma maculatum) and the northern leopard frog (Rana pipens), but I am unaware of any studies to determine if such is the case in ANP.

The surface water study of which I was a part, found that current seasonal fluxes in pH and aluminum in ANP's lakes and major streams are not severe enough or of long enough duration to be of major consequence to aquatic organisms. However, the small first-order brooks are more vulnerable to chemical fluctuation and pH levels may be low enough to cause problems for fish reproduction in the spring. During spring snow-melt the average pH of small brooks declined by half a pH unit and alkalinity declined by 38 percent. The average pH for a brook in mid-March, 1984 was 5.3 which is low enough to inhibit hatching for some fish species. However, most studies on fish reproduction are performed at pH values lower than those of most of ANP's lakes, streams, or brooks. There is one small, high elevation pond in ANP that is acidic with a pH of 4.6 and a negative alkalinity (no buffering capacity). Due to its location, this pond probably never had a fish population and it would not support one now even if stocked.

My major concern for the fresh water aquatic responses of ANP comes from their vulnerablity to continued acidification. Alkalinities are low (<100ueq/l) for ANP surface waters and other chemical analysis or rating systems always rank ANP surface waters as sensitive to acidification. It can not be accurately predicted when major lakes and streams might be acidified to the point of preventing fish reproduction or shifting species composition of invertebrates and plant life, even if it is assumed that precipitation pH levels remain constant. Sediment records from the three ANP ponds suggest a gradual pH and alkalinity decline in the ponds over the last 100 years. Current alkalinities are low and can average in the teens for lake water in the spring. The possibility does exist that a rapid drop in pH and alkalinity may happen though this would probably be apparent in the brooks before it was evident in the lakes and streams. A reduction in pH and alkalinity is not easily reversed. I believe it is in the best interest of the natural resources of ANP to instigate those actions necessary to reduce the sulfuric and nitric acid imputs into the environment.

With reference to gaseous pollutants, the early attempts at determining sulfur dioxide levels in ANP were ambiguous. The lichen survey of 1983 reports the presents of ten lichen species in ANP that are very sensitive to elevated sulfur dioxide (usually absent with SO_2 levels above 50 ug per cubic meter average annual concentration) and three more species sensitive to intermediate in their response to sulfur dioxide (50-100 SO_2 ug per cubic meter).

Wetmore and Sullivan's report implies that there are no air quality problems in ANP since sulfur dioxide sensitive lichens are present. However, Wetmore and Sullivan do state that lichens are poor indicators of acid deposition and elevated ozone. One lichen genus (Umbilicaria) is at least somewhat sensitive to acid precipitation does show injury symptoms with dead margins of the lichen thallus in several locations throughout the park. Eastern white pine is a much more sensitive bio-indicator of ozone levels than are lichens. Eastern white pines vary in their sensitivity to ozone and this variation has been linked to genetic variability. Samples of eastern white pine collected in the summer of 1983 were confirmed to have ozone injury. In 1983 the Maine State Standard for ozone was violated 101 times and the Federal Standard was violated two times.

Dr. Treshow established 20 permanent eastern white pine plots in the summer of 1984. He ranked the 300 trees in these plots for the amount of ozone injury to the needles as well as rating overall tree condition. At a meeting in November 1984, Treshow gave a preliminary estimate that 40 to 50 percent of the 1984 foliage of these trees was effected by ozone. A final report of this study should be issued shortly. In 1984 the Maine State Standard was violated 87 times; the Federal Standard was not violated in 1984.

A few eastern white pines in ANP are severely affected by ozone. If ozone continues at its present level, such trees will be stressed by the repeated injury and death of needle tissue and the trees will become susceptible to attack by insects and pathogens. If ozone levels are not reduced, it is certain there will be losses in the eastern white pine population of ANP. Ozone also reduces visibility, is an eye irritant, and causes breathing difficulty for people with respiratory problems. Therefore elevated ozone can mean reduced visitor enjoyment of ANP. It is estimated by the State of Maine that one-third of ozone is natural background, one-third is from local sources inside the state, and one-third is from long-distance transport. Controlling both local emissions and long-distance transport will be needed to solve the ozone problem.

As I stated in the beginning of my testimony, management practices for Acadia National Park are different from those of a commercial forest. Scenic beauty, bird watching, berry picking, fishing, and even the bugs are part of the experience. Visitors expect a high quality and safe experience. Their concern is not with lower timber productivity due to air pollution, but with possible loss of certain aquatic species, finding browning or dying trees, or just obstructed views due to a polluted haze. Acadia National Park is a valuable resource for the people of the United States and should be protected.

Statement by Dr. Ellis B. Cowling, Associate Dean for Research,
and Director, Acid Deposition Program, School of Forest Resources
North Carolina State University
Raleigh, North Carolina

Prepared for Hearings on the causes and effects of acid deposition by the House of Representatives Subcommittee on National Parks and Recreation.

Since August 1979 I have served as Program Director for a Cooperative Agreement between the Environmental Protection Agency and North Caroline State University. The purpose of this Agreement is to provide EPA with an improved understanding of the effects of acid deposition on aquatic and terrestrial ecosystems. This Agreement provides a major linkage between the National Acid Precipitation Assessment Program and the community of university scientists who are actively engaged in research on the biological and water-quality effects of acid deposition in the United States.

During 1983 and 1984, I participated in two scientific exchanges on forest decline of forests between West Germany and the United States.

My testimony at these Hearings has been requested because of my knowledge and experience as a scientist. Thus, the ideas described here and in my verbal testimony before the Senate Committee are my own and may or may not be coincident with the policies and attitudes of the institutions and organizations with which I am affiliated.

My testimony consists of two items: 1) a summary of present knowledge about declines of forests and 2) a summary of present knowledge on "acid rain", air pollution, and their effects on our society.

COMPARISON OF REGIONAL DECLINES OF FORESTS IN EUROPE AND NORTH AMERICA: THE POSSIBLE ROLE OF AIRBORNE CHEMICALS[1]

by Ellis B. Cowling

Associate Dean for Research
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ABSTRACT

Human activities of many sorts have been changing the chemical climate of Europe and North America especially since the time of the Industrial Revolution. Regional declines of forests also have been occurring in Europe for the past 200 years and in North America for at least the past century. A total of 18 regional declines of forests have been reported on the two continents. These declines are generally believed to be caused by a specific combination of competitional, physical, biological, and chemical stress factors acting simultaneously or sequentially. Airborne chemicals have been implicated as an important causal factor in only four of these 18 cases. A concensus of informed judgement regarding the possible role of selected airborne chemicals is described. This judgement suggests that ozone and biologically available nitrogen compounds are among the chemical stress factors of greatest probable importance to forests. Other chemical stress factors that may also be involved include toxic gases other than ozone, toxic metals, acids, acidifying substances, and growth-altering organic chemicals. Certain implications of this present consensus are discussed briefly with regard to management of air quality in Europe and North America.

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[1] Many of the ideas described in this summary paper were developed in discussions and observations together with Drs. Peter Schütt, Arthur Johnson, Robert Bruck, Ann Bartuska, Walter Heck, James Galloway, Gene Likens, James Woodman, George Hepting, William Winner, Carl Olof Tamm, Henning Rodhe, Rudolf Husar, Ronald Bradow, Svante Oden, Jack Durham, Paul Manion, David Huston, William Hafley, Donald Marx, Dale Johnson, Steve Lindberg, Peter Rennie, Folke Anderson, Peter Sommers, Hans Martin, Robert Rosenthal, and William Waters. I am very grateful to all of these persons for their contributions to the consensus of informed judgement and other ideas outlined in this paper. Further suggestions for improvement of this summary will be welcome by any scientist who wishes to help advance our present meager understanding of the current declines of forests in Europe and North America.

During the past three decades, scientists, public officials, and industry leaders in Europe and North America have become more and more aware that human activities of many sorts are changing the chemical climate of large regions on both continents. Prior to 1950, pollution of air and water were well known especially because of effects on public health in large cities such as London and Los Angeles. So-called "welfare effects" on aquatic and terrestrial ecosystems were acknowledged, but they were considered to be local events confined almost entirely to the vicinity of metal smelters and other large industrial-urban complexes. Air pollution was considered a local meteorological threat to public health but was not recognized as a regional climatological threat to the productivity or stability of ecosystems. The ideas of long-distance transport of air pollutants and of constant deposition of airborne nutrients and injurious chemicals into aquatics and terrestrial ecosystems were not generally recognized either in science or in public affairs.

To be sure, Angus Smith (1872) had published his magnum opus "Air and Rain: The Beginnings of a Chemical Climatology" nearly a century before. In addition, Erik Eriksson, Christian Junge, and Eville Gorham had published a long series of papers on the linkages between air chemistry and surface water chemistry on both continents (e.g., Eriksson 1952, 1954, 1959, 1960; Gorham 1955, 1957, 1958, 1961; Gorham and Gordon 1960, Junge and Werby 1958). But the work of all these authors was met by a "thundering silence", as Gorham put it so eloquently, until Svante Odén (1967, 1968) published his now famous accusation of an "insidious chemical warfare" among the nations of Europe. Odén's audacious ideas--about the long distance transport of sulfur, nitrogen, and other pollutant chemicals, and especially his predictions of large scale acidification and other changes in surface waters and soils, as well as increased disease in forests--stimulated a veritable storm of public and scientific debate that continues to this day.

Effects on Water Quality, Fish, and Forests

At first, the most important regional-scale effects of airborne chemicals on ecosystems were thought to be the gradual and episodic acidification of sensitive surface waters with attendant effects on fish populations (Hultberg and Stenson 1970, Odén and Ahl 1970, Jensen and Snekvik 1972, Beamish and Harvey 1972). About this same time, the idea of regional-scale accumulation of ozone and other photochemical oxidants was recognized as a possible threat to agricultural crops (NAS 1977) and to certain species of forest trees such as ponderosa and Jeffrey pines in the San Bernardino Mountains of California (Miller and Millecan 1971) and to eastern white pine in the Ohio and Tennessee Valleys of the eastern United States (Berry and Hepting 1964).

In 1963 George Hepting (1963) published his classic paper on the influence of long-term changes in climate on the productivity, health, and stability of forests. Hepting emphasized that long-term climate changes (especially changes in temperature and rainfall patterns) could cause stress in forest trees and other perennial plants just as weather changes cause stress in annual plants. Hepting discussed air pollution in this paper but his strongest point was that changes in the physical climate could effect the health and productivity of forests.

Then, beginning in the late 1970's foresters in many parts of Germany began to see a series of subtle changes in their forests. At first white fir showed renewed signs of an old problem--periodic decline especially of older trees. Later, Norway spruce began to show similar symptoms. And then, all too quickly, it became apparent that nearly every commercialy important species of forest trees were showing evidence of decline in large parts of West Germany and other areas of central Europe. For the first time it appeared likely that airborne chemicals might be among the causal factors involved in a multiple-species decline of forests. Today, we are coming to realize that changes in the chemical climate may be at least as profound in their effects on forests as Hepting (1963) showed was true of changes in the physical climate two decades before.

Objectives

The purpose of this paper is to present a brief summary of the present state of knowledge about regional declines of forests which have occurred in the forests of Europe and North America and to discuss the evidence that various competitional, physical, biological, and chemical stress factors may play a role in these phenomena. This comparison of forest declines in Europe and North America, like an earlier paper on the Waldsterben problem in Europe (Schutt and Cowling 1985), has been written in the hope that it may help attract to the forest decline problems of these two continents, some of the most able minds in plant pathology, plant physiology, soil science, forest ecology, and atmospheric chemistry.

Declines of Forests in Europe and North America

Regional declines of forests are not new. They have been occurring in individual species of trees for at least 200 years in Europe and at least 100 years in North America. At least five regional declines have occurred in Europe and at least 13 other declines in North America during the 20th century. These declines are listed below in approximate order of decreasing relative importance:

Regional declines in Europe:

-- Waldsterben, a multiple species decline of forests in West and East Germany, Czechoslovakia, Austria, Poland, Switzerland, France, Italy, and Sweden. The visible symptoms of Waldsterben were first reported in the late 1970's but its growth effects apparently started in the early 1950's.

-- Tannensterben (white fir decline) in Germany since the middle 1700's.

-- Kiefersterben (Scots pine decline in East Germany and European Russia during the early 1970's.

-- Oak Decline in Germany and especially in France since the early 1900's.

-- Decline of Pinus pinaster on the Atlantic coast of France since the early 1980's.

Regional declines in North America:

-- Beech bark disease in the northeastern USA and southeastern Canada since the early 1940's.

-- Littleleaf disease of shorleaf and loblolly pines in the southeastern USA since the early 1920's.

-- Birch dieback in the northeastern USA and southeastern Canada in the early 1940's through the early 1970's.

-- Pole blight of western white pine in the Rocky Mountains of the western USA since the early 1950's.

-- Oak decline in Pennsylvania, Virginia, Texas, Arkansas, and South Carolina since the mid 1960's.

-- Decline of ponderosa and Jeffrey pines in the San Bernardino Mountains of California since the late 1950's.

-- Regional decline of eastern white pine in the eastern USA and Canada since the early 1960's.

-- Several symptomatically distinct maple declines in the northeastern USA and southeastern Canada since the 1950's.

-- Red spruce and Fraser fir decline at high elevation in the Appalachian Mountains of the eastern USA with visible symptoms since the early 1980's and decreased radial growth since the early 1960's.

-- Decline in growth without other visible symptoms in loblolly, shortleaf, and slash pines in the Piedmont regions of Alabama, Georgia, and South and North Carolina since the mid to late 1970's.

-- Ash dieback in the northestern USA and southeastern Canada since the 1950's.

-- Sweetgum blight in the southeastern USA in the 1950's and 1960's.

-- Decline of growth without other visible symptoms in pitch and shortleaf pines in the Pine Barrens region of New Jersey.

Waldsterben in Europe is by far the most important of all the regional declines of forests observed during the present century. This is true for several reasons--the most importance is that Waldsterben is the first multiple-species decline of forests reported in either Europe or North America. In fact, essentially all native and exotic tree species are affected as well as some shrubs and herbs. Waldsterben is also very important because of: a) the large geographical area affected; b) the very great commerical and aesthetic value of the declinng forests to the people of Europe; c) the remarkable diversity of physical, chemical, climatic, soil, site, and forest management conditions in which damage has been observed; and d) the unique symptoms shown by the trees, several of which have never been seen before.

Symptoms of Decline in the Forests of Europe and North America

Careful study and analysis of symptoms is the first and most important step in the identification of the causal factors involved in any disease of living organisms. Table 1 contains a comparison of the major symptoms observed in the declines of forests in Europe and North America. Some of the most important conclusions that can be drawn from this tabulation include the following ideas.

1) The symptoms of decline in forest are diverse and often specific to a particular species of trees.

2) Although there are some similarities, there are many more differences among the symptoms of decline observed in Europe and those observed in North America. This is not surprising since the tree species that are native to Europe are not the same as those in North America. But Norway spruce, which is widely planted as an ornamental tree in North America, is showing nearly identical symptoms of stress on both continents.

3) One of the most important similarities is the tendency for yellowing of foliage to progress from the lower to the upper parts of the canopy and from the inner to the outer portion of branches, oldest tissues affected first. This symptom has been observed on both continents - mainly at high elevation in Europe and in the San Bernardino and Appalachian Mountains of North America. Another similarity is decreases in diameter growth of conifers on both continents, but these growth effects are more gradual in Europe and more synchronous in North America.

4) Some of the most important differences in symptoms between North America and Europe include: a) the greater frequency of dying back from the top--youngest tissues affected first--in North America than in Europe; b) the greater frequency of abnormal-growth symptoms (symptoms 9-15 in Table 1) in Europe than in North America; and c) the substantial number of symptoms observed in Europe (symptoms 8, 9, 10, 11, and 14 in Table 1) that are reported only rarely or not at all in North America; and d) the greater frequency of decrease in growth without other visible symptoms of damage in North America than in Europe.

Concept of Multiple Causality of Declines in the Forests of Europe and North America

Regional declines of forests on both continents are believed to result from the combined action of several different competitional, biological, physical, and chemical stress factors that act simultaneously or sequentially to induce the symptoms of damage. One of the most widely accepted concepts of causality (Manion, 1981) holds that these three general types of stress factors act cumulatively as follows:

-- Predisposing competitional, physical, chemical, or biological factors which usually apply long-term chronic stresses.

-- Inducing or inciting biological, physical, or chemical factors which usually apply short-term acute stresses; and

-- Contributing competitional, biological, or physical stress factors which usually apply long-term stresses.

Although the concept of multiple causality has gained wide acceptance in both North America and in Europe, there is much less agreement among scientific specialists about which factors are predisposing, inducing or inciting, and contributing in any given decline of forests.

The competitional stress factors of importance to forests include competition for water, nutrients, and light are well as allelochemical interactions among individual both within and among species. Competition by hardwoods against conifers and among conifers in the same stand is often very keen, especially in even aged stands. Mortality induced by competition is an important feature of all planted and naturally regenerated forests. Only a few trees in the original stand will survive to maturity.

The biological stress factors of importance to forests include pathogenic and injurious fungi, insects, nematodes, bacteria, viruses, viroids, plasmids, mycoplasmas, and parasitic seed plants. The most important, by far, of these biotic stress factors in forests are fungi and insects.

The physical stress factors of importance to forests include wildfire and controlled burning of forests; extremes of heat and cold, especially rapid changes leading to sun scalding or frost injury; extremes of moisture supply, including both drought and flooding, as well as high winds and low humidity which contribute to moisture deficiency or to frost damage and winter desiccation.

The chemical stress factors of importance to forests include the following: toxic gases such as ozone and sulfur dioxide; excess nutrient substances especially nitrogen; toxic elements such as lead, cadmium, and fluorine; acidic substances such as sulfuric and nitric acids; acidifying substances such as ammonia vapor, and nitrate or ammonium sulfate aerosol; and growth-altering organic chemicals such as ethylene and aniline.

It is important to realize that the airborne chemicals of importance to forests include beneficial as well as injurious substances. The beneficial substances in the atmosphere include 16 chemical elements that are essential for growth of forest trees--carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, manganese, iron, copper, zinc, molbdenum, boron, and chlorine. All 16 of these essential elements can be taken up rapidly by forest trees directly through their foliage and green shoots as well as through their roots. Although attention is currently focused on injurious airborne chemicals, beneficial effects of airborne nutrients should always be recognized as a part of the normal growth and development processes in forests.

Possible Role of Airborne Chemicals in Declines of Forests

Clearly, not all regional declines of forests are caused by air pollution. Among the 18 regional declines listed earlier, airborne chemicals are considered to be a major causal factor in only four cases. These four are: a) the declines of Jeffrey and ponderosa pine in the San

Table 1. Comparison of Symptoms of Decline in Forests of Europe and North America

Symptoms	Europe	North America
Growth-decreasing symptoms:		
1. Yellowing of foliage from the lower to the upper and from the inner to the outer portion of branches -- oldest tissues affected first.	Observed mainly in white fir and Norway spruce at high elevation.	Observed with white fir in the San Bernardino Mountains and recently in red spruce in New England and the southern Appalachians.
2. Dying back from the top of trees -- youngest tissues affected first.	Common in oak and ash, less common in birch and beech.	Conspicuous in red spruce, maple and oak declines; ash and birch diebacks.
3. Increased transparency of crowns due to gradual loss of leaves but with leaves retained to the very top of the trees.	Observed in Norway spruce, white fir, Scots pine, larch, beech, birch, oak, maple, ash, and alder.	Observed only in the littleleaf disease of shortleaf pine and in the beech-bark disease.
4. Losses of fine-root biomass and mycorrhizae (beneficial symbiosis between tree roots and soil fungi).	Common in white fir, Norway spruce and beech. Not studied in other species.	Observed mainly in red spruce and Fraser fir declines, birch dieback, and little leaf disease.
5. Synchronized decrease in diameter growth without other visible symptoms.	Not reported in Europe.	Observed in pitch pine and shortleaf pine.
6. Synchronized decrease in diameter growth with other visible symptoms leading to death.	Not reported in Europe.	Observed in red spruce and Fraser fir mainly at high elevation. Also ponderosa pine and Jeffrey pine.
7. Progressive decrease in diameter growth with other visible symptoms leading to death.	Studied mainly in Norway spruce, white fir and beech. Not studied in other species.	Observed in ash and birch diebacks, some maple and oak declines, sweetgum blight, littleleaf disease, and pole blight.
8. Death of herbaceous vegetation beneath some affected trees.	Observed in high elevation spruce and medium elevation beech forests.	Not observed in North America.

Symptoms	Europe	North America
Abnormal-growth symptoms:		
9. Active casting off (abscission) of leaves and shoots while still green.	Common in spruce, fir, and beech, ash larch, Scots pine, maple, and oak.	Reported only twice in North America, in loblolly pine and red spruce.
10. Change in relative length of long shoots and short shoots.	Common in beech and larch.	Reported only in the mycoplasma-induced "yellows" of ash.
11. Stork's nest crown formation in white fir	Common in white fir.	Not reported in North America.
12. Concentration of leaves in tufts or clumps at tips of branches.	Common in oak and ash.	Observed in nearly all declines of broad-leaved trees.
13. Change in size and shape of leaves.	Common in beech, occasionally in spruce, fir, birch, and oak, and Scots pine.	Common in white pine, littleleaf disease of shortleaf pine, and some maple and oak declines.
14. Excessive production of adventitious (out-of-place) shoots on branches.	Common in Norway spruce, White fir, and larch.	Observed recently for the first time in high altitude conifers. Common in maple and oak, ash, and birch.
15. Excessive production of seeds and cones.	Common in spruce, fir, beech, and birch; often observed several years in a row.	Observed in many stressed trees but mainly one year at a time.
General observations:		
Many different species suddenly showing substantially similar symptoms.	Yes.	No.
Commercial forests showing extensive decline.	Yes.	Yes.
Soil relationships.	Trees affected on nutrient-rich and nutrient-poor soils, acid soils and basic soils.	Trees affected more on nutrient-poor and acid soils.

General observations continued:

Elevation relationships.	Needle-bearing trees affected at all elevations.	Needle-bearing trees affected mainly at high elevation.

Symptom 3 has not been reported before 1979 affecting more than one species of trees.

Symptoms 8, 10, 14, and 15 have not been reported before 1980 affecting any tree species.

Symptom 9 has been reported only twice in North America and not before 1979 in central Europe.

Bernardino Mountains of California; b) white pine decline in the eastern USA; c) Waldsterben, the general decline of softwood and hardwood forests in Europe; and d) the declines of red spruce and Fraser fir in the Appalachian Mountains from Maine to North Carolina in North America.

The quality of evidence that airborne chemicals are important in these forest declines varies greatly among these four cases. The strongest cases are the San Bernardino Mountain and white pine declines. In these cases, a) geographical gradients in damage are correlated with geographical gradients in ozone concentration (Miller et al. 1977, Skelly et al. 1983, Miller 1983); b) the major symptoms (yellowing and necrosis of foliage, decline in rate of growth, and death of trees) can be reproduced by exposure to ozone; and c) genetic variation in susceptibility and resistance to damage in the field is correlated with genetic variation in susceptibility and resistance to ozone in controlled exposures (Berry and Hepting 1963, Benoit et al. 1982).

In the case of Waldsterben, the evidence is less strong. Here, geographical gradients in damage are not well correlated with geographical gradients in concentration and/or deposition of any known air pollutants. But in at least one of the provinces of West Germany, Baden-Wurttemberg, the amount of damage to trees was greater on trees of greatest exposure to moving air masses. This was shown with regard to predominant wind direction, altitude, position within a stand (edge vs center), position within the canopy (dominant vs non-dominant trees), type of forest (pure softwood vs mixed softwood and hardwood forests), etc. (Institute for Forestry Experimentation and Research 1984). Also, no known biotic, physical, or soil-chemical factors were well correlated with damage. Finally, controlled exposure to ozone and to ozone plus acid mist has reproduced one of the symptoms (yellowing of spruce foliage) observed in the forest.

In the case of red spruce and Fraser fir declines, the evidence is weakest of all (Siccama et al. 1982; Johnson and Siccama 1983; Bruck 1984). Here, the amount of damage (decrease in diameter growth, loss of foliage and root biomass, and mortality of the trees) is greater at high than at low elevation. This is consistent with altitudinal gradients in concentration of ozone and other known pollutants, time of exposure to nutrient-rich and acidic cloud water, and accumulation of lead and other toxic metals. Neither controlled exposure tests nor genetic tests with resistant and susceptible genotypes have been done with red spruce or Fraser fir.

Airborne Chemicals of Greatest Probable Importance in the Current Declines of Forests

Except in the cases of ozone in the San Bernardino Mountain and white pine declines, present published evidence is not adequate to definitively link specific airborne chemicals to any particular decline of forests in either Europe or North America. On the basis of general knowledge of the responses of forests to stress, some circumstantial evidence, and a very few controlled-exposure tests, however, a consensus of informed judgement is developing that the airborne chemicals of greatest probable relevance to the current declines of forests include the following in approximate order of decreasing importance:

1) Ozone.

2) Total biologically available nitrogen compounds. This includes wet and dry deposition of all biologically available gaseous, aerosol, and dissolved or suspended forms of nitrate nitrogen (NO_3^- and HNO_3 vapor), ammonia nitrogen (NH_3), and ammonium nitrogen (NH_4^+).

3) Other phytotoxic gases, including nitrogen oxides (NO_x), sulfur dioxide (SO_2), fluorine (Fl), and both peroxacetyl nitrate (PAN), and peroxyproprionyl nitrate (PPN).

4) Toxic metals especially lead (Pb) and cadmium (Cd), and possibly also zinc (Zn) and copper (Cu).

5) Nutrient and acidity-determining cations and anions in wet and dry deposition ("acid deposition"), including potassium (K^+), sodium (Na^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), hydrogen (H^+), nitrate (NO_3^-), sulfate (SO_4^{2-}), phosphate (PO_4^{3-}), and chloride (Cl^-).

6) Growth-altering organic chemicals such as ethylene and aniline.

Investigating the possible role of each of these six classes of airborne chemicals in the decline of forests in Europe and North America will require a substantial research effort extending over many years.

Rationale for the Ranking of Probable Airborne Chemical Stress Factors

Toxic substances are more likely to cause detrimental effects on plants than nutrient, acidic, or acidifying substances. Gases such as ozone have a greater potential for detrimental effects on plants than other physical forms of airborne chemicals (fine or coarse aerosol particles or substances dissolved or suspended in precipitation). This is true because gases can enter plants from the atmosphere directly through the stomata on leaves and green shoots. By contrast, aerosol particles and substances dissolved or suspended in precipitation can enter plants only after dissolution and/or diffusion through the protective surfaces of plants. These protective surfaces include the waxy cuticle of leaves and green shoots and the bark or other suberized tissues on the surface of twigs, branches, stems, and roots. Substances entering plants through roots would also have to survive the biological and physical adsorption and absorption hazards of percolation and/or diffusion through the pore structure of soils before entering plants.

Phytotoxic concentrations of ozone commonly occur in forests in Europe and North America. Toxic concentrations of nitrogen oxides, sulfur dioxide, peroxyacetyl nitrate, or peroxyproprionyl nitrate occur relatively infrequently in forests remote from point sources of pollutants.

Ozone accumulates in phytotoxic concentrations in all industrial regions of the world even at substantial distances from major sources of air pollutants. Ozone is a product of photochemical oxidation processes which occur whenever the precursor airborne chemicals [mainly oxides of nitrogen (NO_x) and volatile organic substances (VOC) such as unburned hydrocarbons, organic solvents, and other substances] are exposed to sunlight in air. For this reason, ozone is a regional rather than just a local hazard to normal growth and development of forests.

Ozone is known to cause severe injury and even death of certain forest trees. The best-known cases are white pine in much of eastern North America and ponderosa and Jeffrey pines in the San Bernardino Mountains of California.

Ozone acts synergistically with other pollutants. Ozone has been shown to cause more damage to certain agricultural crops in the United States and to spruce seedlings in West Germany when the exposure occurs in combination with other air pollutants such as sulfur and nitrogen oxides or simulated acid mist (Trajonis and Jacobson, personal communication; Prinz, personal communication).

Other toxic gases such as SO_2, NO, and NO_2 occur much less frequently in phytotoxic concentrations than ozone.

Although nitrogen is one of the most important nutrients required by forest trees for normal growth and development and is the element which most often is limiting to forest growth and productivity, it is also known to have certain detrimental effects on forest plants when deposited in greater than normal amounts and/or concentrations. These detrimental effects include the following: i) stimulation of increased growth leading to increased demand for all other essential nutrients and thus to deficiencies of other nutrient elements (Abrahamsen 1980); ii) increased susceptibility to frost and to winter desiccation due to delay in conversion of starches to sugars and/or in formation of protective cuticle on leaf surfaces (Tisdale and Nelson 1975, Friedland et al. 1985); iii) inhibition or necrosis of mycorrhizae--beneficial associations of fine feeder roots with certain soil fungi which assist in uptake of nutrients and water and afford protection against feeder-root pathogens of forest trees (Bjorkman 1949, Shafer et al. 1985); iv) predisposition to increased attack by foliage- and root-disease fungi (Huber 1980) and by insects (Hain 1984); v) changes in the relative amounts of shoot growth with respect to root growth (Aung 1974); and vi) alterations in patterns of nitrogen transformation in forest soils including nitrification, denitrification, and possibly biological fixation of nitrogen (Arthur Johnson, personal communication).

Certain toxic metals are known to accumulate in the organic matter and lesser vegetation on the floor of forests. This accumulation of toxic metals in forest floor materials is especially pronounced in high-elevation boreal forests (Johnson et al. 1982, Friedland et al. 1984b, 1984c) where other environmental conditions are also severe. However, current evidence suggests that available metal concentrations have rarely reached phytotoxic levels except near metal smelters and certain other point sources of these pollutants.

Simulated rain artificially acidified with sulfuric acid or mixtures of sulfuric and nitric acids have generally not been injurious to forest trees in controlled exposure experiments unless extraordinarily acidic solutions (les than pH 2.5) were used. This observation has been made repeatedly in experiments both in Europe and in North America. Acid deposition effects on soils and on mycorrhizae have yet to be evaluated fully.

Very few growth-altering organic compounds are known to be dispersed through the air in concentrations that would be injurious to plants. Nevertheless, the possibility exists that some among the myriad of commercially important volatile organic chemicals produced in industrial regions could prove to be injurious by inducing abnormal growth in forest trees. The observations of Cheesman et.al. (1980) with regard to aniline and of Canadian scientists with regard to ethylene (Hutchinson, personal communication) are examples worthy of further attention.

The order of probable importance of these various airborne chemicals differs somewhat according to elevation. For example, atmospheric deposition of biologically available nitrogen compounds and toxic metals are more likely to be important in high-elevation than in low-elevation forests. Ozone, either alone or in combination with other toxic gases and drought, is the airborne chemical must likely to be important in low elevation forests.

Research efforts to determine the role of various airborne chemicals must not be separated from efforts to understand the normal functioning of forest ecosystems and their responses to competitional, physical climate, and biotic stress factors. Airborne chemicals do not act in isolation from the diverse competitional, physical, and biological stress factors that are a part of the dynamics of growth, development, productivity, disease, senescence, and death that are evident in all wild and managed forest ecosystems.

Implications for Management of Air Quality in Europe and North America

For some years or even decades now, the forests and surface waters of large parts of Europe and certain high-elevation, industrial, and urban locations in North America have been receiving much heavier loadings of nutrients, toxic, acidic, acidifying, and growth-altering chemicals than during the preindustrial period in which these ecosystems evolved. In some locations, essentially all the nutrients needed to grow some forests are now provided by deposition from atmospheric sources. Under these new circumstances, it should not be surprising that some beneficial and some detrimental changes in the health, productivity, and stability of forest ecosystems are being induced by these long-term regional, and even continent-wide changes in the chemical climate.

Sulfur dioxide is undoubtedly not the only airborne chemical injurious to aquatic and terrestrial ecosystems in Europe and North America. If ozone, biologically available nitrogen compounds, or toxic metals prove to be among the airborne chemicals that have significant detrimental effects on forests, it may be desirable to decrease regional emissions of nitrogen oxides, volatile organic compounds, and toxic metals, either simultaneously with, or independently of, possible future decreases in emissions of sulfur dioxide.

Significant decreases in emissions of sulfur dioxide, nitrogen oxides, and volatile organic compounds are likely to have significant and simultaneous beneficial effects on human health, visibility, materials damage, surface water quality, and both crop and forest productivity.

As a consequence of the long-distance transport of pollutants, their multiplicity, and the extensive mixing and complex chemical interactions among pollutants in the atmosphere, an integrated (multiple pollutant and regional) program for management of air quality would have several advantages over the present single-pollutant and state-by-state or province-by province methods of planning both in Europe and North America.

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Pollution in the Air and Acids in the Rain: An Analysis of Present Knowledge and Certain Research Needs in the Southern United States

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Acid deposition or "acid rain" as it is more popularly known, has been a major topic of scientific and public concern in Europe since the late 1960's and in North America since the early 1970's. But, the phenomenon is not really new. Acid deposition is a product of the widespread use of fossil fuels which became necessary as the industrial revolution gathered momentum in the middle of the 19th century. Since the industrial revolution began in England it should be no surprise that the first reports of strong acids in rain also were made in England about the middle of the last century.

In 1852, an English chemist named Robert Angus Smith completed a detailed analysis of the chemistry of precipitation in and around the city of Manchester. Twenty years later, after extensive observations and experiments in Germany, France, and England, Smith published a truly remarkable 600-page book entitled "Air and Rain: The Beginnings of a Chemical Climatology." In this book he enunciated many of the ideas we now consider part of the acid deposition phenomenon. These ideas include regional variation in precipitation chemistry as it is influenced by such factors as combustion of coal, decomposition of organic matter, wind direction, proximity to urban areas and the sea, amount of rain, etc. Smith proposed detailed procedures for the proper collection and chemical analysis of rain and snow. He also noted air pollution damage to plants and materials and atmospheric deposition of arsenic, copper, and other toxic metals in industrial regions. All this b the year 1872!--a full hundred years before widespread interest in the phenomenon and effects of acid deposition in North America!

Today we are all very much more aware of the occurance and detrimental effects of regional air pollution and acid deposition than we were in the last quarter of the 19th century or even the first seven decades of of the 20th century. Nevertheless it is useful to review a few general ideas about air pollution, acid deposition, and their effects on our society before we discuss the current needs for research on these subjects in the southeastern U.S.A.

Major Air Pollutants of Concern to Society

As shown in Table 1, the air-borne chemicals of major concern to society include two major types of pollutants (primary and secondary) and eight specific chemical or physical groups of pollutants. Primary pollutants are gaseous or volatile waste products emitted directly from stationary and mobil sources. Stationary sources include power plants, metal smelters, and other industrial or commercial installations, as well as domestic space and water heating units. Mobil sources are mainly automobiles, trucks, aircraft, and other transportation vehicles. Secondary pollutants include a wide variety of substances formed in the atmosphere by chemical transformation of primary pollutants.

The six most important primary air pollutants are sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, toxic elements such as lead and fluorine, and particulate matter. The two most important secondary pollutants are photochemical oxidants and acid deposition. Acid deposition and particulate matter can occur as both primary and secondary pollutants.

Major Effects of Air Pollutants on Society

As summarized in Table 2, air pollutants cause eight different kinds of effects. All except the last effect (fertilization of crops, forests, and surface waters) are detrimental to the interests of society. Note especially that: 1) sulfur dioxide (SO_2) emissions are directly involved in all eight effects; 2) that nitrogen oxide (NO_x) emissions are involved in seven of the eight effects, and 3) that volatile organic compounds (VOC) or their photochemical derivatives such as ozone (O_3) contribute to five of the eight effects. All three of these primary pollutants are produced during combustion of fossil fuels. These three pollutants also serve as the most important chemical precursors of photochemical oxidants, acid deposition, and certain types of particulate matter (See Table 1). These are the major reasons emissions from combustion of fossil fuels are so universally important determinants of air quality in all industrial regions of the world.

Present State of Knowledge

During the past 25 years knowledge about air-borne chemicals and their effects has increased enormously. At present we know a great deal about the chemical nature of air pollutants and their transformation products; their general meteorological and climatological dispersal patterns; the mechanisms of transfer of pollutants from the atmosphere to the surface of the earth; the chemical, physical, and biological nature of their effects on human health, materials, atmospheric haze, and aquatic ecosystems; and gaseous pollutant effects on crops and forests.

This rapidly expanding body of knowledge has lead to the following general principles regarding air pollution and its control. 1) Combustion of fossil fuels is the single most important general source of air pollutants. 2) The concentration and deposition of primary air pollutants decreases progressively with increasing distance and time after emission from any particular emission source. 3) The concentration and deposition of secondary pollutants is a complex function of meteorological, seasonal, altitudinal, temporal,

Table 1. Air Pollutants of Major Concern to Society.

Chemical and Physical Nature of Pollutants:

1) Sulfur dioxide (SO_2)--A colorless gas produced during combustion of sulfer-containing material (i.e., coal and oil) and during smelting of sulfide metal ores. SO_2 is emitted mainly by large stationary sources such as fossil fueled power plants, metal smelters, and certain other industrial and commercial installations.

2) Nitrogen oxides (NO_x)--Two colorless gases (NO and NO_2) produced in any high temperature processes (i.e., combustion of coal, oil, gasoline, and natural gas). NO_x are emitted by both stationary sources and transportation vehicles.

3) Toxic elements--Lead, cadmium, nickel, fluorine, and other toxic elements released mainly by large metal smelters and by transportation vehicles using leaded gasoline.

4) Volatile organic (VOC)--A wide variety of carbon compounds ranging from such simple molecules as ethylene, gasoline, and cleaning and painting solvents to very complex molecules such as pesticides. VOC are produced by many different, usually small, stationary and mobile sources.

5) Carbon Monoxide (CO)--A colorless and oderless but highly toxic gas produced during incomplete combustion of coal, oil, gas or incineration garbage and other waste products. Carbon monoxide inhibits respiration in humans and other animals. It is of concern to society mostly in urban areas where it accumulates in stagnant air mainly from transportation vehicles.

6) Particulate matter--Particulate matter is a catch-all category of pollutants. The substance of concern range from very coarse "fugitive dust" particles that cause soiling of textiles windows, paints, etc., to very fine aerosol particles that cause atmospheric haze or are drawn into lungs where they induce respiratory disease.

These substance are very diverse, both chemically and physically. The larger particles range from almost pure carbon in the case of soot from oil burners to mineral dusts in the case of manufacturing facilities that produce cement, asbestos, clay, ceramic, textile, and other materials. The fine particles range from smoke to all sorts of sulfate ammonium, organic, metallic, and other fine aerosol particles formed by condensation of gases and other volatile substances in the atmosphere. Some of these particles have very remarkable and complex fine structure that are characteristic of the original sources of the emissions.

7) Ozone (O_3) and other photochemical oxidants--These substances occur only as secondary pollutants. They are produced when NO_x and VOC interact with atmospheric oxygen in the presence of sunlight. Ozone is the most important photochemical oxidant. It is one of the most toxic gas to which plants and human beings are exposed in the environment.

8) Acid deposition--Acidic and acidifying substances produced when SO_2, NO_x, and HCl combine with oxygen and moisture in the air to give aqueous solutions or aerosols of sulfuric, nitric, and hydrochloric acids. Acid deposition occurs when these substances are dissolved in rain, snow, hail, dew, and fog (wet deposition). It also occurs by dry deposition of sulfate, nitrate and chloride aerosol particles and as gaseous SO_2, NO_x, HNO_3, and HCL. The acidic substances in wet and dry deposition may be partially or completely neutralized by alkaline earth elements such as calcium, magnesium, potassium and sodium, or by ammonium ions. Acidification of aquatic and terrestrial ecosystems also occurs when ammonium sulfate aerosol and certain other ammonium compounds or ammonia itself are taken up by plants after deposition into ecosystems.

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Table 1. Major Effects of Air Pollution on Society.

Type of Effect	Nature of Effect	Pollutants Involved
1) Effects on human health due to inhalation of air-borne chemicals	Pulmonary disfunction, respiratory disease, and mental retardation (especially in children)	Ozone Sulfur dioxide Nitrogen oxides Particulate matter Carbon monoxide Toxic elements
2) Effects on human health due to atmospheric deposition or leaching and later ingestion of air-borne or soil-borne chemicals via drinking water, fish, or other food products	Diarrhea and mental retardation in children and poisoning of adults by lead, mercury, copper, cadmium, or other toxic elements	Toxic elements Acid deposition
3) Materials damage	Increased corrosion of metals; accelerated weathering of stone and masonry; soiling of textiles, glass, masonry, and other materials; deterioration of paints, plastics and rubber	Sulfur dioxide Nitrogen oxides Particulate matter Ozone Acid deposition
4) Increased, haziness of the atmosphere	Decreased visibility in urban and rural areas with attendant decreases in airport safety and enjoyment of scenic vistas from aircraft and in parks	Particulate matter Sulfur dioxide Nitrogen oxides Volatile organic compounds Photochemical oxidants
5) Fumigation of crops and forests	Decreased growth and yield of crops and forests	Ozone Sulfur dioxide Nitrogen oxides Toxic elements
6) Acidification of aquatic and terrestrial ecosystems	Death and reproductive failure in fresh-water fish, decreased fertility of soils	Sulfur dioxide Nitrogen oxides Acid deposition
7) Decline of forests	Decreased growth, increase mortality, and predisposition of forest trees to biotic and abiotic stress factors	Ozone (?)[1] Nitrogen oxides (?) Ammonia and ammonium nitrogen (?) Sulfur dioxide (?) Acid deposition (?) Toxic elements (?)
8) Fertilization of crops, forests, and surface waters	Increased productivity of crops; forests, and surface waters	Nitrogen oxides Ammonia and ammonium nitrogen Sulfur dioxide Acid deposition Particular matter

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[1] Question marks indicate major continuing uncertainty about the role of specific pollutants even though the involvement of air pollutants

geographical, and other factors. 4) The elapsed time between emission and deposition varies with the pollutant in question but ordinarily ranges from a few minutes or hours to a maximum of 4 or 5 days. 5) This time is sufficient for dispersal over both short distances (0-500 Km) and long distances (> 500 Km). 6) The averge annual zone of influence of any particular emission source extends in all directions from the source, and is roughly symmetrical with the center of the deposition field generally displaced from the source by a distance of only a few tens of or perhaps hundreds of Km. 7) For these reasons, no state or province can control the quality of air within its own borders without cooperation by other nearby states or provinces. 8) The atmosphere over most industrial regions is very well mixed; also the distance between most sources of air pollution is much smaller than the average distance of dispersal from any given source. 9) Thus, pollutants rarely, if ever, occur alone; in addition, they frequently react with each other leading to new chemical products and interact so as to produce combined effects which can be additive, synergistic, or antagonistic. 10) For many pollutants and biological effects there is no distinct "threshold dose" or "safe concentration" below which we are certain there will be no adverse effects; thus, any important decrease in emissions is very likely to result in decreased adverse effects. 11) Significant decreases in air emissions of SO_2, NO_x, and VOC are very likely to have significant and simultaneous beneficial effects on human health, visibility, materials damage, surface water quality, and both crop and forest productivity. 12) If a decision were reached in 1984 or 1985 to achieve significant additional decreases in air emissions of SO_2, NO_x, or VOC, it will take at least 3 years to develop specific state, provincial, regional, national, or international implementation plans and at least another 5 years to design and build the machinery and control systems that would be necessary.

For all of the above reasons, it seems prudent that the United States and Canada earnestly continue their historic air-quality planning and evaluation procedures. In doing so, leaders of industry and government should recognize that: 1) research is continuing; 2) an integrated (multi-pollutant and regional) program for management of air quality would have many advantages over the present single-pollutant and state-by-state or province-by-province methods of planning; 3) cooperation, consultation, and statesmanship may produce more economically and scientifically sound management plans than legislatively mandated solutions; and 4) the earliest possible date for significant decreases in emissions (except through energy conservation and decreased use of energy and materials) will be in the mid 1990's.

Needs for Further Research in the Southeastern USA

Among all the effects of air pollutants listed in Table 2, none is more urgently in need of further research in the southeastern U.S.A. than item 7--the role of air pollutants in forest declines. This sense of urgency was increased greatly by observations of very widespread decline of forests in central Europe since 1979 and in certain parts of the Appalachian Mountains since 1981.

Beginning in the late 1970's economically valuable forests containing ten different species of hardwood and softwood trees showed a very rapid and scientifically unprecendented series of disease symptoms in large parts of West Germany and nearby nations of central Europe. These remarkable symptoms include both growth-decreasing and abnormal-growth phenomena. The growth-decreasing symptoms include loss of foliage, loss of fine feeder roots, decreased diameter growth (width of annual rings), premature death of older needles in softwood trees, increased susceptibility to secondary root and leaf pathogens, death of affected trees, and death of herbaceous vegetation. The abnormal-growth symptoms include active casting off of green leaves and green shoots, altered form and structure of leaves and branches, altered allocation of the products of photosynthesis, and excessive seed and cone production. These symptoms, some of which have never been seen before, are shown by trees growing at high and low elevation; on nutrient-rich and nutrient-poor soils; on acid soils and basic soils; in natural stands and in planted stands; in mature forests of 80 to 300 years, in middle age forests of 40 to 80 years, and in young sapling stands of 5 to 40 years. A survey completed in 1983 showed that 34% of the total forest area of West Germany contained trees showing various degrees of forest decline symptoms.

Recent changes in the growth and behavior of forests have also been observed in certain parts of eastern North America. A widespread, simultaneous, and abrupt decrease in rate of diameter growth (width of annual rings) since the early 1960's has been reported in red spruce, pitch pine, and shortleaf pine in the northern part of its range. The area of affected spruce extends from southeastern Canada to the southern Appalachian Mountains. On the slopes of Mount Mitchell and other nearby peaks in North Carolina, Virginia, and Tennessee, both red spruce and Fraser fir show marked loss of foliage, loss of fine feeder roots, and decreased annual increment (width of growth rings). These symptoms are more pronounced at high than at low elevation. At present, reliable evidence of air pollution damage to low elevation commercial forests in the southeastern USA relates primarily to ozone damage, especialy on white pine.

Some similarities and many differences are apparent in comparing the regional symptoms of decline in the forests of Germany and eastern North America. In North America, red spruce trees are clearly dying back from the top. This "crown dieback" symptom is found almost exclusively in forests at high elevation where contact with cloud moisture is commonplace and where the stands of trees are not of great economic value. In Germany, by contrast, the trees are clearly declining (showing sparse foliage and slow growth) rather than dieing back from the top. This condition is not confined to high-elevation or cloud-covered forests. It occurs in many different species of trees which are of very great economic value. Thus, it is not appropriate to assume that the changes taking place in Germany are the same as those taking place in the United States.

Nevertheless, it is widely assumed (and I think correctly so) that air pollutants and/or acid deposition are among the stress factors that have caused or are contributing to the symptoms observed in the forests of central Europe and in the high elevation forests of eastern North America. But these ideas are still only hypotheses; they have not been proven beyond reasonable doubt.

Specific Research Plans

During the past several months, plans for a major program of research on forest declines in the high elevation spruce and fir forests of the southeastern USA has been developed by the Southern Appalachian Research/Resource Management Cooperative (SARRMC). Financial support for this effort is being provided to the Southeastern Forest Experiment Station of the U.S. Forest Service from resources allocated by the Congress of the United States to the National Acid Precipitation Assessment Program.

The SARRMC organisation is ideally suited to the development of a regional cooperative program of research in this area of science. SARRMC is a consortium of four federal agencies (the U.S. Forest Service, the National Park Service, the Tennessee Valley Authority, and the U.S. Fish and Wildlife Service) as well as six universities of the southern Appalachian region (the

University of Georgia, University of Tennessee, Clemson University, Virginia Polytechnic Institute and State University, Western Carolina University, and North Carolina State University). At the request of the Southeastern Forest Experiment Station, the SARRMC Executive Committee arranged for a regional conference on spruce-fir decline and requested that the most able scientists in the SARRMC member organizations submit proposals for research to accomplish four specific objectives:

1) Define and delineate the Southern Appalachian spruce-fir ecosystem boundaries;
2) Delineate the geographical extent of symptoms of ecosystem decline;
3) Determine the incidence and magnitude or severity of decline; and,
4) Evaluate possible biotic and abiotic causes of decline in the Southern Appalachian spruce-fir ecosystem and develop scientific tests for these hypotheses.

A total of 30 specific research proposals from more than a dozen institutions are currently being evaluated by a Peer Review Committee after preliminary screening by a program Management Team. Final decisions about these proposals will be made by the SARRMC Executive Committee on the recommendations of a SARRMC Technical Committee for the proposed "Southern Appalachian Spruce-Fir Ecosystem Assessment Program."

This rather elaborate evaluation procedure has been designed to ensure that the most able and keenly interested scientists in the southern Appalachian region can become involved in a well-coordinated program of research to fulfill the four major objectives outlined above.

I believe that this research will make a significant contribution to available knowledge about spruce-fir decline.

"EVERYTHING IS HITCHED TO EVERYTHING ELSE"

AN EVOLVING PERSPECTIVE ON AIR POLLUTION IN NATIONAL PARKS

20 May 1985

SYSAPP-85/090

Prepared for

Committee on Interior and Insular Affairs
Subcommittee on National Parks and Recreation
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"Everything is Hitched to Everything Else"

An Evolving Perspective on Air Pollution in National Parks

My name is Douglas Latimer and I hold the position of Principal Environmental Engineer at Systems Applications, Inc. of San Rafael, California. For several years, even before the 1977 Clean Air Act Amendments established the national goal of protecting visibility in national parks and wilderness areas, my colleagues at Systems Applications and I have been involved in technical studies related to visibility impairment. Under the sponsorship of the EPA, we developed the technical guidance for evaluating the visibility impacts of new emission sources such as power plants and oil shale production facilities used by most states and industrial groups in this country. This guidance includes computer models that use emission and meteorological data to calculate visibility impacts within approximately 50 miles of emission sources. More recently, under the primary sponsorship of the National Park Service and the EPA, we have developed, tested, and applied regional models designed to calculate air quality, visibility, and acid deposition impacts over regions spanning 1000 miles.

This morning I would like to discuss a change in perspective regarding air pollution in the national parks that has occurred in the last 10 years. This change involves a gradual broadening of our understanding and awareness. For example,

1. Our focus has changed from a nearly exclusive concern with pollution sources within a few miles of national parks to a broad, regional concern with the cumulative contributions of sources hundreds of miles from these parks.

2. We are now discovering that the major air pollution issues of concern regarding national parks and wilderness areas are acid rain and regional haze and that they are interrelated because the same pollutants and sources, by and large, are responsible.

3. It is also becoming apparent that acid rain programs will have far-reaching benefits, not only for a limited number of remote lakes, streams, and trees, but also for the human environment. Benefits to human health and the longevity of man-made structures and materials

are likely. To reduce acid rain, we have to first clear our skies. With improved visibility, our urban landscapes as well as our national parks will be more beautiful.

The EPA's first phase of visibility regulations was promulgated in December of 1980 in response to the 1977 Congressional visibility mandate. These regulations were designed to restrict the intrusion of smoke, dust, discolored smog, and haze (so-called plume blight and layered haze) produced within the first few tens of miles of industrial facilities. Although the states and the EPA are still in the process of adopting implementation plans for these regulations, it is my view that this regulatory phase has worked. During the last few years, industry has sited new facilities at sufficient distances from parks to minimize visual intrusions. Although this siting has resulted in some constraints on industry (especially on electric utilities, as shown in Exhibit 1), industrial growth has not been significantly affected, in my opinion.

More recently, concerns have been raised regarding the more serious visibility problem of regional haze. Emissions of fine particles, sulfur dioxide, and nitrogen oxides from urban areas and industrial facilities can be transported hundreds, even thousands, of miles. These emissions chemically react in the atmosphere to form sulfates and nitrates that are the principal causes of regional visibility impairment and acid deposition. The resulting haze is relatively uniform, extending many miles from pollution sources, and is particularly thick in the summer when photochemical reactions are most rapid. Recently, a government task force, headed by EPA, has been studying whether regional haze should be explicitly regulated. As part of this effort, Systems Applications has recently performed studies of regional visibility in both the East and the Southwest, and I would like to share some of the insights gained from these two draft studies.

Probably the most important finding is that sulfate formed in the atmosphere from sulfur dioxide emissions is the largest single contributor to regional haze in this country. From measurements made in many urban areas and national parks, and from our own computer modeling studies, we find that sulfate constitutes about 50 percent of the man-made haze in both the East and the West. In the summer, the sulfate contribution can be as much as 70 to 80 percent of man-made haze. Exhibit 2 shows the significantly different concentrations of sulfate in the East and Southwest determined from both measurements and models. In the East, annual average sulfate concentrations are as high as 10 to 12 $\mu g/m^3$ in the Ohio River Valley; while in the Southwest, sulfate concentrations are typically only 1 $\mu g/m^3$, in nonurban areas such as the Grand Canyon. The factor of 10 difference in concentrations of sulfate and other fine particles between the Ohio River Valley and the Grand Canyon largely explains the factor of

10 difference in regional visibilities: visibility in the East is typically 10 miles, whereas in the Grand Canyon it is typically 100 miles. The factor of 10 difference in sulfate concentrations in the East and Southwest is also consistent with the fact that SO_2 emissions in the two regions also differ by a factor of 10; in the East about 25 million tons per year; in the Southwest about 2.5 million tons.

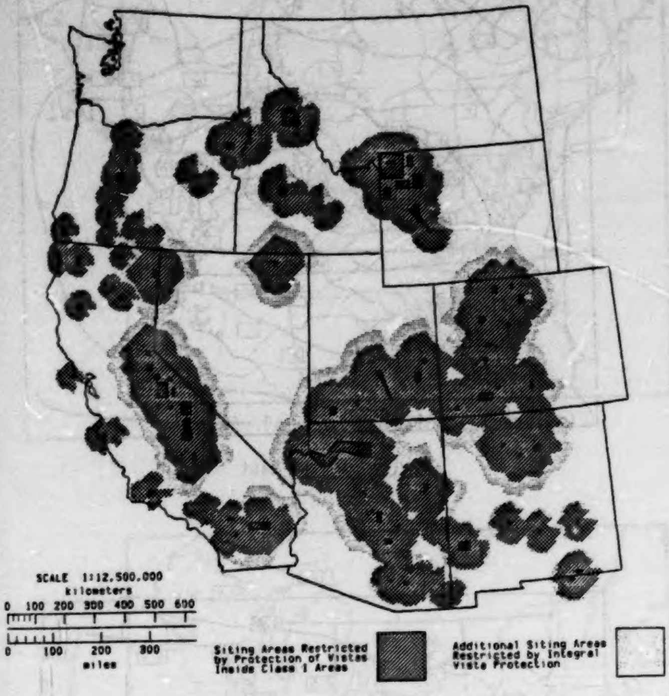
Now, suppose we consider the effects of a 31-eastern-state acid rain control program that would control 50 percent of current SO_2 emissions, that is, about a 12 million ton reduction in the East. In the East, a 50 percent reduction in SO_2 emissions is expected to reduce sulfate concentrations as much as 40 to 50 percent. This would result in a 25 to 33 percent increase in visibility. Because sulfate accounts for a large fraction of summer haze, such emission controls would improve summer visibility more--up to 60 percent in the East.

Since visibility improvements would be noticeable almost every day of the year, not only at scenic vistas in the Shenandoah, Adirondacks, and Great Smoky Mountains, but also in New York, Chicago, and other urban areas where most of the 160 million people in the East live. If we use economists' estimates of people's willingness to pay for improved visibility of about 2 cents per day per person for a 10 percent improvement, we calculate a regional visibility benefit of billions of dollars a year for such an acid rain program. These benefits are sizeable fractions of control costs even without considering other potentially larger benefits such as reduced damages to lakes, streams, forests, man-made materials and structures, and human health.

Another application of computer models involves tracing pollution from individual urban areas, power plants, and smelters to find out where it is carried and deposited. Exhibit 3 illustrates one example. Let me direct your attention to the top figure, which shows the relative effect of 1 ton/year of SO_2 emitted from various locations in the East on acid rain in the Adirondacks. Note from the figure that a ton of SO_2 emitted in New York State would be expected to have at least twice as big an effect as a ton emitted in the Midwest. Multiplying these unit impacts by the current emissions in the East, as shown in the lower figure in Exhibit 3, we obtain a picture of the sources contributing to acid rain in the Adirondacks, namely the Canadian smelters and the U.S. power plants in the Ohio River Valley. If this analysis is repeated to evaluate which sources are contributing to haze in the Great Smokies or in urban areas, we find that, by and large, the same sources contribute.

As shown in Exhibit 4, a similar analysis has been performed in the Southwest using computer models. We found that emissions from the smelting, electric utility, and oil industries, and from urban areas, contribute not only to man-made haze in the Grand Canyon but also to acid rain in the Colorado Rockies. We believe that such model calculations, together with the analysis of measurement data, will be useful in evaluating the relative contributions of different sources of SO_2 and NO_x to regional visibility and acid deposition problems.

Noting the many interconnections in ecosystems, John Muir once remarked that "Everything is hitched to everything else." Today, when we consider air pollution in the national parks, we find similar interrelationships. Pollution sources hundreds of miles distant contribute to the haze and acid rain observed in our national parks and wilderness areas. We find that the problems of acid rain and visibility impairment are linked. As a result, acid rain controls in this country are likely to have far-reaching benefits, not only on ecosystems, but also on human health, the longevity of man-made structures and cultural objects, and the scenic beauty of our parks and urban areas.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Siting Areas Restricted by Protection of Vistas Inside Class 1 Areas
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EXHIBIT 1. Power plant siting constraints in the vicinity of national parks and wilderness areas necessary to limit plume blight impacts.

SYSTEMS APPLICATIONS, INC

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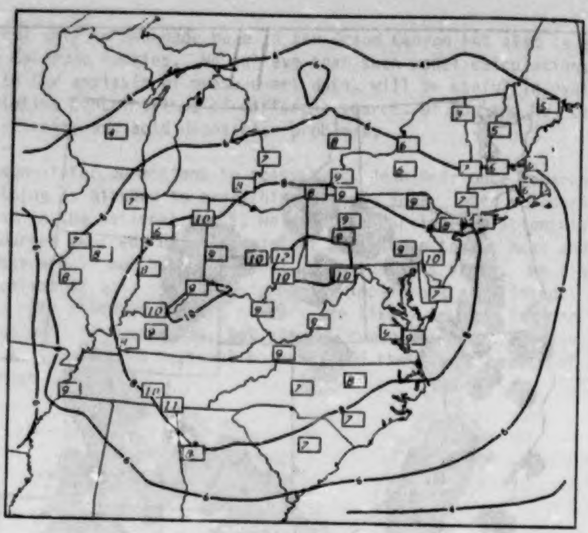
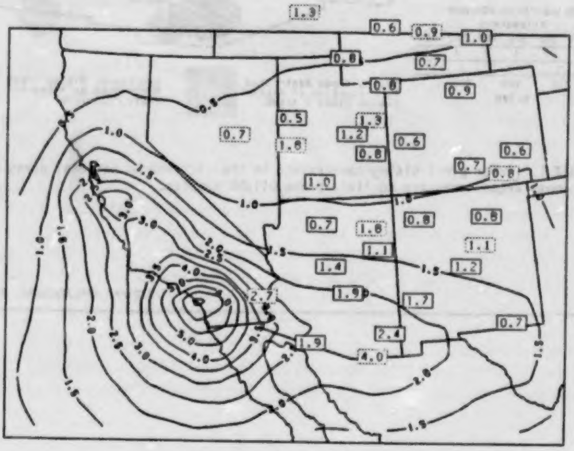


(a) In the East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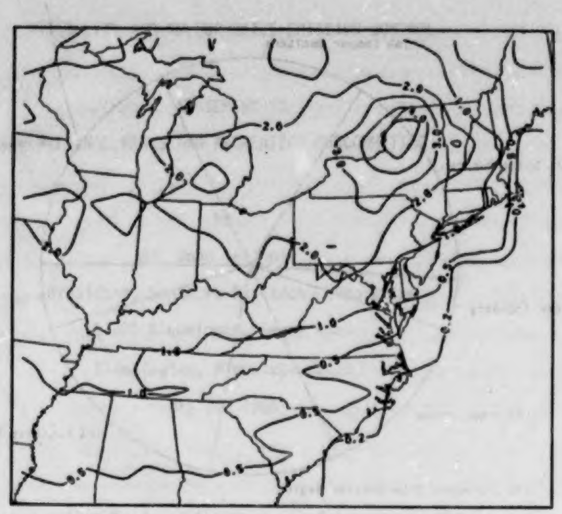
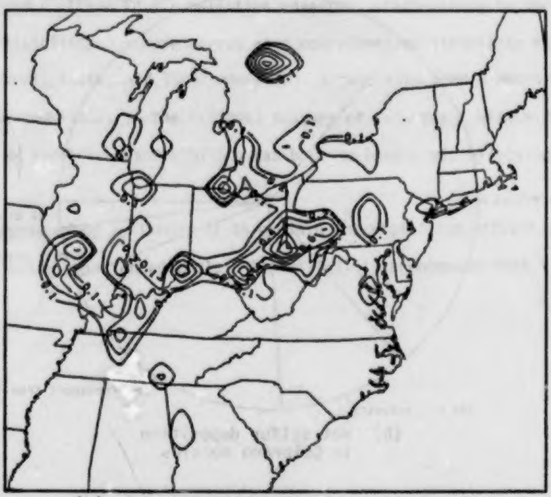
(b) In the Southwest

EXHIBIT 2. Comparison of predicted and measured annual average SO_4 concentrations ($\mu g/m^3$) in 1977-1978. (Measured values are shown in boxes.)

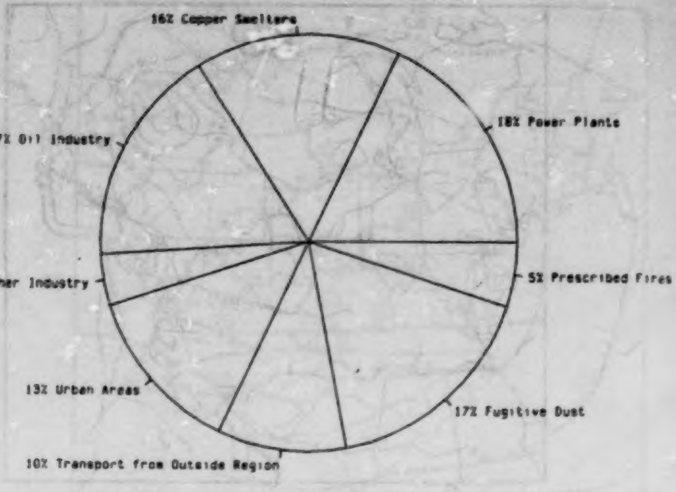

2.0
2.0
2.0
1.0
1.0
1.0
0.5
0.5
0.5
0.5
0.2
0.2

(a) For unit emissions (1 ton/yr)

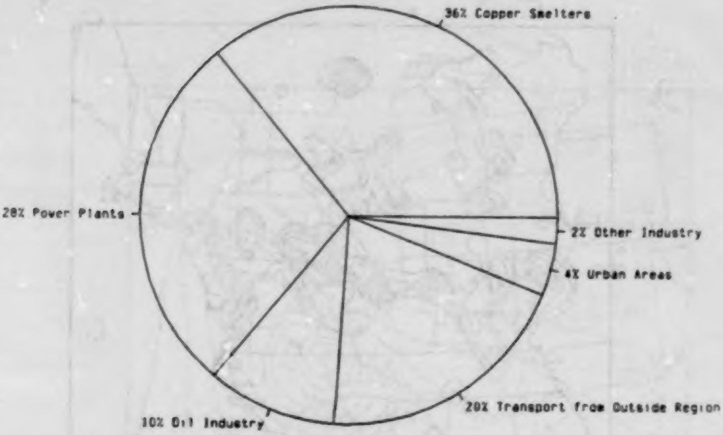


(b) For 1980 point source emissions

EXHIBIT 3. Relative effect of SO_2 emitted at various locations in the East on wet sulfur deposition in the Adirondacks.



(a) Man-made haze in the Grand Canyon



(b) Wet sulfur deposition in Colorado Rockies

EXHIBIT 4. Estimated percent contributions of emission source categories to regional haze and acid deposition at two locations in the Southwest in 1981.

VISIBILITY AND SULFUR OXIDE EMISSION CONTROL

STATEMENT TO
NATIONAL PARKS AND RECREATION SUBCOMMITTEE

by

Dr. John Trijonis
President, Santa Fe Research Corporation
11200 Bloomington Ferry Road
Bloomington, Minnesota 55438

May 20, 1985

Mr. Chairman and other distinguished Members of the Subcommittee:

My name is John Trijonis. I received a Ph.D. in Environmental Engineering Science from the California Institute of Technology in 1972. Since that time, I have followed a career in air pollution research, specializing in the area of atmospheric visibility. I have served as a consultant on visibility for numerous federal, state, and local agencies. I have also been a member of five air pollution committees of the National Academy of Sciences. Within these NAS committees, my specific responsibility has been to handle visibility-related issues.

The purpose of my testimony is to explain the visibility effects associated with sulfur oxide emission controls. The visibility phenomenon that I will be discussing is large-scale regional haze over the eastern United States. I will illustrate the effects of emission controls by describing visibility levels for three cases: (1) current conditions, (2) the proposed 31-state, 12-million-ton SO_2 control scenario, and (3) natural background conditions. For all these cases, I will discuss average visibility levels over the entire eastern U.S. (states east of the Mississippi). The exact visibility conditions and improvements would, of course, vary above and below this average from day-to-day and from site-to-site.

To start, I would like to explain that sulfur oxide emissions are of critical and unique importance to atmospheric visibility. The atmospheric end products of sulfur oxide emissions are sulfate particles -- particles composed of sulfuric acid and/or ammonium sulfate. These sulfate particles are very effective in scattering visible light because of two reasons. First, sulfate particles tend to form in the size range of 0.1 to 1 micron diameter, by far the most efficient size range for scattering visible light. Second, sulfate particles are hygroscopic (water-attracting), and they draw a substantial amount of atmospheric water from the gaseous phase into the (light-scattering) droplet phase.

It is now well established that sulfur oxide emissions are the dominant contributors to visibility reduction (haziness) in the eastern United States. As shown on the left hand side of the first poster, visual range over the East currently averages about 12 miles (in scientific terms, equivalent to a light extinction level of 200 Mm^{-1}). Sulfates presently contribute about 55 percent of this visibility reduction.

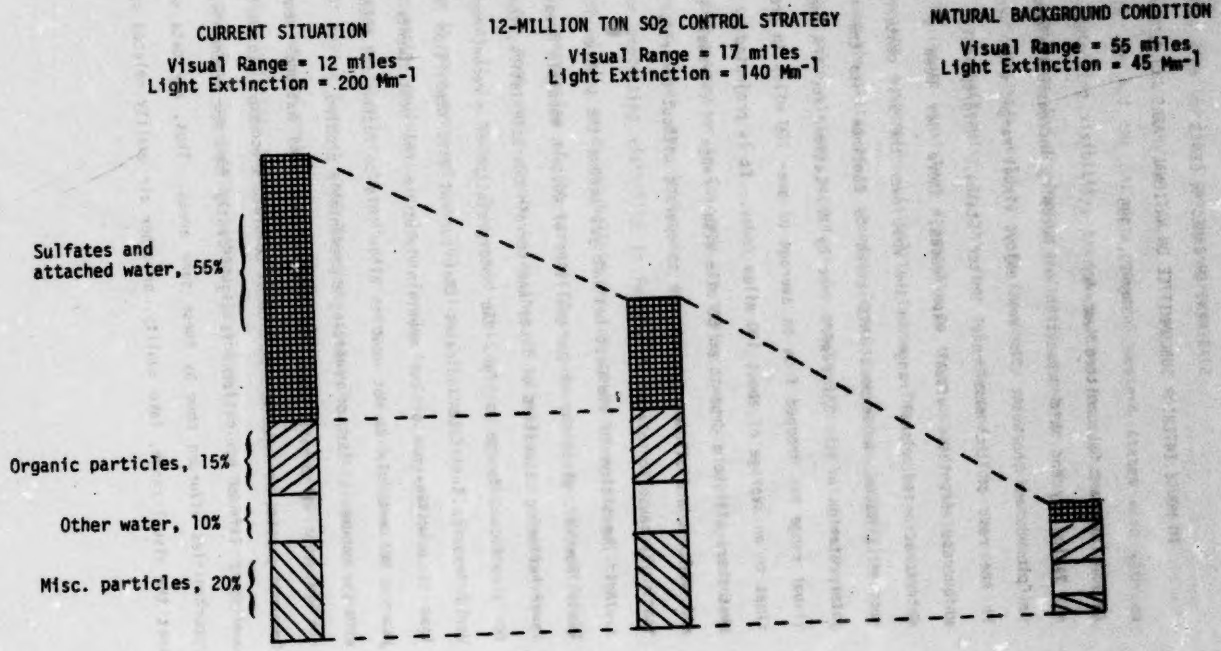
The 12-million-ton strategy would reduce SO_2 emissions by 60 percent in the 31-state control region. This would decrease atmospheric concentrations of sulfate particles by slightly more than 50 percent averaged over the East. Assuming other factors would remain unchanged, the average light extinction level would decrease by 30 percent, and the overall visual range would increase from 12 to 17 miles (about 40%). This case is illustrated by the center column of Poster 1.

As a reference point, it is interesting to consider the level of visibility that would exist if all man-made particles in the atmosphere were controlled. As shown on the right hand side of Poster 1, natural background visual range in the East is approximately 55 miles, about 4 to 5 times greater than current visual range.

Next, I would like to discuss the degree to which these visibility improvements are perceptible. In side-by-side comparisons of photographs, the threshold for a perceptible difference is approximately a 5 to 10 percent change in visual range. When views are not compared simultaneously, so that memory is required, the threshold for perceptibility is about a 10 to 15 percent change in visual range. Thus, the 40 percent improvement in visual range for the 12-million-ton strategy should be quite perceptible. The 400 percent change in visual range to natural background is obviously very apparent.

The second poster presents photographs that illustrate average visibility levels for the three conditions discussed previously. These photographs were collected as part of scientific field programs at Shenandoah National Park and Great Smoky Mountains National Park. As indicated by comparing the first two columns of photographs, the visibility improvement produced by the 12-million-ton control strategy would be perceptible. It should be noted, however, that it is difficult to illustrate with exactness the visibility change from the 12-million-ton strategy because of uncertainities in quantifying the visibility represented by the photographs. The difference between current and natural visibility levels, on the other hand, is very large so that the relative uncertainity of the photographic technique is less. The photographs demonstrate that the change to natural background conditions would be very striking.

LEVELS OF VISIBILITY REDUCTION (LIGHT EXTINCTION) IN THE EASTERN U.S.



STATEMENT OF JAMES M. LENTS
TO HOUSE INTERIOR SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION
May 20, 1985

Mr. Chairman and Subcommittee Members:

Visibility and acid deposition are becoming increasingly important issues in Colorado and the West. The West enjoys visual ranges which are unsurpassed in the rest of the continental United States. Unfortunately, despite the uniqueness of these visual experiences, there has been a considerable deterioration of visual range in the West over the past century,and unless action is taken, we expect this trend to continue into the future. Our interpretation of the SAI report done by Mr. Latimer for EPA indicates that visual range has dropped from an average of over 160 miles in pre-industrial times to an average of about 100 miles today. It is projected by Mr. Latimer that there will be a drop to an 85 mile visual range if oil shale is developed and smelters are allowed to continue to operate without controls. This data is clearly cause for alarm.

Acid deposition in the West has not yet become the problem it is in the East. However, given the unique qualities of western mountain areas, e.g. the lower buffering capacities of lakes and terrain characteristics, the potential for significant damage is high. Our interpretation of a recent report by the World Resource Institute indicates that current acid deposition rates could lead to acidification of our mountain lakes in the next twenty to thirty years. We certainly do not want to allow this to happen and then be faced with the monumental task of reversing a preventable problem.

The many Wilderness Areas, National Parks, and National Monuments in Colorado provide an important portion of Colorado's economy. In addition, the quality of life of our citizens is significantly impacted by the recreational opportunities afforded them by these same areas. Thus, any data suggesting that the visual range, lake quality, or other air quality related values may be significantly impacted is of great concern to us.

Even before we had the SAI data, several western states also with an interest in protecting visibility, banded together on a project to develop some common approaches for developing visibility standards. We knew that the actual level of standards would be up to the policy makers in each state, but wanted to insure uniformity in the form of standards for the ease of regulation, to insure consistent approaches to those being regulated, and to educate ourselves concerning visibility issues. The project resulted in agreement among the states as to standard form and served to identify the many technical and policy issues needed to be resolved in the standard setting process.

One of the reasons we in Colorado are moving towards visibility standards is our concern over the inadequacy of the current pollution increment approach for protecting visibility in Federal Class I and II areas in our state. First of all, we do not believe the increments themselves will protect visibility. Consumption of the current Class I increment for TSP uniformly throughout the West would result in another 25 mile loss in average visual range from what it is today. This would yield an average visual range of 80 miles where it once averaged over 160 miles. If the Class II increment was added to existing pollutant levels uniformly in Colorado, our visual range would decrease by 60 miles, to a 45 mile average. We also believe the current practice of having Federal Land Managers assess air quality related values, AQRV's, as a means of protecting visibility in Class I areas is inadequate for accomplishing visibility goals. Not only is the process arbitrary, but the arbitrary decisions are made by technocrats and not policy makers. It is our belief that the Federal government should establish regional standards for visibility in Class I and II areas and eventually for all urban and rural areas. The EPA presently argues that this is currently not allowed under the Clean Air Act. They argue that they are only allowed to establish national standards. This position by EPA is a prime motivator for the State of Colorado to move towards a visibility standard of its own. Clearly, a standard set to protect visibility nationwide would not protect visibility in Colorado or the rest of the West.

Another reason for taking a regional approach to visibility, and also the acid rain issue, is the contribution of long range transport to both problems. The SAI study indicates that more than half of the visibility impact in the Flat Tops Wilderness area in western Colorado comes from outside Colorado. Salt Lake City and Los Angeles are the largest urban contributors to this degradation. Salt Lake City is estimated to contribute 8% of the degradation in western Colorado, and Los Angeles is estimated to contribute 7% of the degradation. The SAI study did not deal with the individual impact of industry, thus the specific interstate impact of industry could not be evaluated. To deal with this transport issue, expanded regional analysis techniques far beyond today's capabilities are needed.

The western states have also joined together to look at the acid rain issue. Funding provided by the EPA will be used to aid with this project. However, to fully reach our goal of enabling states to deal with the complex issue of their state's impact in another state or on Federal Lands, more resources may be necessary in the form of inventory technique development and modeling technique development.

I would now like to discuss our specific efforts in Colorado as they relate to my previous points and our interest in visual air quality.

In 1977, the Colorado Legislature decided the areas identified in the Clean Air Act as Class I areas in Colorado were inadequate for air quality protection. Thus, the Legislature created a Colorado Category I designation to protect eight additional areas from SO_2 impacts. This flegling effort, although somewhat ineffective, points to the concern in our state for these important outdoor areas. The State Health Department is currently undertaking studies to determine if two of these eight should be reclassified to Class I areas. We feel the additional protection available under the Class I status may be helpful in preventing further visibility degradation and acid deposition impacts particularly from outstate sources. It should be noted that not only would visibility standards provide more protection, but acid deposition standards would also be better than the Class I increment process.

I would now like to show you some pictures reflecting current visual air quality in Denver. Admittedly, we never expect to have air quality conditions in our mountain recreation areas like we have in Denver, but we believe certain levels of deterioration we have experienced in Denver have, or could, occur in some of our more pristine areas. The pictures you see represent different visual range situations. The first picture represents almost perfect, or Rayleigh, visibility. As you look towards the mountains to the right, the visual range in this picture is 233 miles. I also indicated average visual range in western Colorado was 105 miles - this is represented by the third picture. The second picture represents visual range of about 170 miles. As I previously mentioned, this represents the average visual range that existed before settlement in the West. The uniform consumption of the Class I and II increments is roughly illustrated by pictures 4 and 5, respectively. They represent visual ranges of approximately 35 and 75 miles, respectively.

One is ultimately lead to the bottom line question: Is there anything that can be done to stop the decline in visual air quality and the potential slow acidification of our mountain lakes? Can some of the lost visual air quality be recouped? I don't have adequate data to clearly answer this question today; however, I would like to provide an increment of data that provides some light at the end of the tunnel. The SAI study breaks out the sources of visual degradation on west central Colorado as follows:

SOURCE	APPROXIMATE IMPACT*
Industrial Sources	56%
General Manmade Fugitive Dust	26%
Prescribed Burns	5%
Gasoline Vehicles	4%
Diesel Vehicles	4%
Other Mobile	4%
Residential Commercial Heating	1%

*Includes estimate of sources outside of SAI study region

73% of existing major Colorado SO_x sources and 42% of existing major Montana SO_x sources have no SO_x control. If this is indicative of other western states, then considerable potential exists for achieving some meaningful SO_x reductions in the West if it is determined that such is needed. As much as an overall 30% SO_x reduction may be easily achievable based on this data. Similarly, industrial NO_x emissions generally go uncontrolled. Although NO_x is harder to control, it is likely that an overall 10% reduction could be achieved from stationary sources.

We have been concerned by what we consider a softening of EPA's position on the control of diesel emissions evidenced by their recent heavy duty vehicle standards. Over the next fifteen years, it may be possible to achieve another 10% or greater reduction in NO_x emissions and fine particulates from vehicles if standards are set at the tougher end of the spectrum.

This suggests that a 10-15% visibility improvement may be realizable in addition to that accomplished through smelter control and other existing emissions control programs. Of course, the advent of new sources will mitigate the potential improvements.

It would be inappropriate to use the numbers I have just provided other than to determine the need to investigate further reduction potential from existing western sources, and to continue to review the need for tougher controls on mobile sources. It is my concern that EPA and the states are not taking a broad enough view of the value of controls on many stationary and mobile sources.

In conclusion I would suggest that Congress consider the following two recommendations:

A. Congress should mandate a process to develop regional visibility and acid deposition standards. There should be a mandatory set of standards that apply to all Federal Class I areas since they are our national treasures. Two or three other levels should be developed which may be selected by states for different areas such as urban, state parks, and such. The standard setting process should involve the states as well as federal land managers. Once a state adopts standards for its different areas, a process should be established to prohibit other states from violating the selected limits in another state.

B. Simultaneous to the standard setting process, an accurate western inventory should be developed which includes emission rates, existing levels of control on sources, and the potential for reasonable further control on each source. A process should be developed to maintain this inventory into the future. This inventory should include mobile and other area sources as well as the stationary sources. This information would enhance the process of correcting existing visibility impairment and studying the effect of adopting different levels of standards. It should be noted that theoretically this information exists. Also, NAPAP and the Congressionally funded STAR project in the west in which Colorado is involved is attempting to address this issue. However, the NAPAP and STAR projects seem to have inadequate levels of funding for the west. In addition, many western states have traditionally had smaller, more poorly funded air pollution control programs. This has not contributed to well developed computerized inventory systems.

STATEMENT OF THE WESTERN REGIONAL COUNCIL
ON AIR QUALITY IN NATIONAL PARKS
PRESENTED BY
J. ROBERT WHITE AND EDWARD HAASE
BEFORE THE
SUBCOMMITTEE ON PARKS AND RECREATION
HOUSE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

MARCH 20, 1985

Mr. Chairman and Members of the Subcommittee:

I am J. Robert White, Vice President and Special Assistant to the Chairman of Valley National Bank of Arizona. I appear before you today as Chairman of the Western Regional Council Clean Air ad hoc Committee. Appearing with me is Edward Haase, Senior Environmental Analyst for Phelps Dodge Corporation, a member of the Western Regional Council.

The Western Regional Council (WRC) is an organization of the chief executive and chief operating officers of more than 40 companies engaged in a broad variety of business activities in the Western United States. The WRC represents financial, mining, utility, investment, construction, transportation, accounting, engineering, oil and gas, and other business enterprises. One of the primary purposes of the Council is to establish a balanced viewpoint between the need for a safe and clean environment in which to live and the need for a healthy and active economy in our region.

The WRC has been actively interested and engaged in air quality issues since it was organized in 1977. We have worked with the Congress, the Administration, and with Western Governors on those clean air and air quality issues that uniquely impact the West.

Air quality in our national parks uniquely impacts the West and is of particular interest to the WRC and its member companies because a significant number of our large national parks and park system units are located in the western United States. WRC members not only work in the West, but also live in the West. The quality of our lives is enhanced by the beauty and accessibility of many of our national parks. They provide scenic and recreational opportunities not only to us and our families, but also to others across the country and around the world. The tourism they generate provides important direct economic benefits to our states and communities. Their existence also indirectly provides economic growth and other benefits to our region and to the entire nation. The geologic and other forces that created many of the scenic treasures that typify national parks in the West also created or made accessible natural resources critical to our nation and its people. WRC members have become good neighbors to parks while making available or developing such resources as water, oil and gas, hard rock minerals, etc. These and other factors give the WRC a unique perspective and interest in the parks located in our region.

Consequently, we appreciate this opportunity to share our perspective at this hearing. In our brief oral statement today, we will summarize several basic issues regarding air quality in the western United States and in those national parks located in our region, including air quality improvements, air quality and related research and reports, acid deposition, and visibility. More detailed information on each of these issues is provided in our written statement which has been submitted to the Subcommittee. We may supplement or amend our statement, pursuant to your rules and procedures, within ten days.

The Western Regional Council first wishes to emphasize that while the Clean Air Act can be improved and should be amended, it and other factors are already working to provide significant improvements in air quality in the West, including in our national parks in the West. Unfortunately, the fact of this improvement is not often heard in the clean air debate. We would like to give some specific examples and documentation.

Much of the attention of Congress in recent years, and of some of the previous witnesses at this hearing, has been on sulfur emissions. Present-day anthropogenic sulfur emissions in the eleven western states are actually lower than they were 35 years ago. Considering the remarkable growth that has occurred in the western states since 1950, that is a major achievement.

But that is not the only good news. Under the present clean air laws, sulfur emissions between now and the year 2000 are projected to decrease even further in the West. This means that, under current law, sulfur emissions in the year 2000 will be lower than those that occurred a half century earlier in 1950!

What is the source of this information? These projections are contained in figures published in the recent World Resources Institute (WRI) report on acidic deposition in the West. Unfortunately, neither the text nor the summary of that document reports this information. In fact, while the summary concludes that SO_2 emissions may remain approximately constant in the West through 1990, projections contained in Figure 14 of the main report clearly show a projected decrease of more than 600,000 annual tons. This is due primarily to copper smelter emission reductions already required by law.

Figures in the WRI report and from other sources documenting decreased sulfur emissions and sulfur dioxide ambient air quality levels in the West are further confirmed by the EPA National Air Quality and Emissions Trends Report released earlier this month (May 9, 1985).

The EPA report generally concludes that the nation's air is improving every day and that, as EPA Administrator Lee Thomas summarized, "it is far cleaner today than it was eight years ago...." Specifically, the report concludes that nationwide sulfur dioxide ambient air quality levels improved 36 percent, sulfur oxide emissions improved 19 percent and ambient particulate levels improved 20 percent. Data and charts within the report, itself, depict specific improvement in the West.

Other region-specific data also confirm emission reductions in the West. A report commissioned by the Environmental Improvement Division of the State of New Mexico concluded that statewide New Mexico emissions of the "two pollutants most subject to control policies at the state level, SO_x and TSP, have declined dramatically during the late 1970's; SO_x emissions will soon be back down to the level of the 1940's, and TSP emissions will soon be only a fraction of the early 1940's level."

Why are SO_2 emissions in the West lower today than they were in 1950? Two of the major reasons relate to successful implementation of the Clean Air Act.

First, between 1970 and 1980, overall SO_2 emissions in the West were decreased by more than 1,300,000 annual tons. Nearly all of that SO_2 reduction was due to the installation of constant emission controls required by the Clean Air Act on copper smelters which occur in the West, primarily in the Southwest. This reduction did not come cheaply. The non-ferrous metals industry has spent nearly $1.5 billion on air pollution controls. This involved a higher percentage of capital expenditures for pollution than for any other industry.

Second, coal-burning power plants in the eleven western states account for less than 3% of U.S. power plant SO_2 emissions, primarily as a result of constant emission controls required by the Clean Air Act and the burning of low-sulfur western coal.

A good example of power plant emission reductions is found in the Four Corners region (Arizona, New Mexico, Colorado and Utah), a region in close proximity to national park system lands. New controls at the Four Corners Power Plant are reducing total emissions by more than half. This improvement counters the invalid assumption in the WRI report that utility emissions in the West, especially the Four Corners region, will significantly increase.

Unfortunately, the debate over such issues as sulfur emissions and concentrations, acidic deposition, and damage or potential for damage to national parks or other resources is often driven by inaccurate summary statements or "desired" conclusions rather than by actual scientific evidence or documentation. A good example of this problem involved the observations, last year, of two scientists and the unsupported and, as we later learned, inaccurate conclusions of subsequent media and other reports that acid deposition damage had occurred to forests in the vicinity of Gothic, Colorado.

Earlier this year the EPA supported an investigation by a group of scientists on the health of forests in the vicinity of Gothic, Colorado. The EPA team of scientists, led by Dr. Robert Bruck of North Carolina State University, was unanimous in its conclusion that, although trees showed natural symptons of decline, there was no evidence that atmospheric deposition of any kind was contributing to or exacerbating this natural process. In fact, some tree increment cores showed a marked increase in growth over the past twenty years. The EPA team of scientists concluded that both sulfate and nitrate deposition in Colorado were well below values believed to cause either aquatic or terrestrial damage and were well below values found in the eastern U.S.

Therefore, despite statements common in the news releases, articles and media reports concluding that there is evidence of acid deposition damage to national parks in the West, there is, in fact, no valid scientific evidence documenting acidic deposition damage anywhere in the West.

Unfortunately, some allegations regarding acid rain damage in the West are based on conclusions drawn from research in the East. Notably, in 1980, SO_2 emissions from the State of Ohio by itself were approximately the same as the total SO_2 emissions from all of the eleven western states, an area almost 29 times larger than Ohio. Thus, it is not surprising that precipitation acidity in the rural northeastern U.S. has typically been about nine times more acidic than in the rural West based on results from the precipitation monitoring system of the National Atmospheric Deposition Program. Similarly, sulfur deposition is typically several times greater in the Northeast, and nitrate deposition is also considerably greater in the Northeast than the West.

In considering the potential for acid deposition damage to parks in the West, it is important to realize that SO_2 emissions in the West were significantly greater than at present for at least 10 to 15 of the years between 1960 and 1980, often by more than one million tons per year. However, even in past years, emissions were considerably less than in the eastern U.S., and, perhaps more important, as previously noted, there are no scientifically documented cases of damage due to acidic precipitation in the West.

Since no known acid precipitation damage occurred in the West when SO_2 emissions were much higher, and present SO_2 emissions are lower and are projected to decrease even further over the next 15 years, it is difficult to understand the specter of future acid rain doom in the West that has been raised by some groups and individuals. This is especially true since, as pointed out in the World Resources Institute report, potentially sensitive ecosystems are not typically located near areas of highest sulfur and nitrogen deposition in the West.

The State of Arizona is a good case in point. Arizona SO_2 emissions were reduced by approximately 1,400,000 tons between 1970 and 1980, much more than in any other state in the Nation. And yet, despite the high SO_2 emissions of past years, the Arizona Clean Lakes Classification Study in 1983 showed that none of the sampled 84 Arizona lakes were below the critical alkalinity sensitivity level of 200 microequivalents per liter.

A 1984 study by Ashbaugh et al. in the journal, Atmospheric Environment, utilized sulfur data from forty stations in eight states of the Western Fine Particle Network. Their spatial pattern analysis showed the Arizona and New Mexico sulfur deposition was negatively correlated with sulfur deposition in northern Colorado, northern Utah and Wyoming, indicating that sulfur emission products in the southern Rocky Mountains are not transported in significant amounts to the northern Rockies or to parks in that area.

A recent U.S. Geological Survey study analyzed stream chemistry between 1965 and 1981 at benchmark stations throughout the United States, a period when SO_2 emissions in the West, particularly Arizona, decreased significantly. Although stream acidity did slightly decrease in Arizona during that period, it actually increased slightly in Colorado, indicating that Arizona SO_2 emissions apparently do not measurably affect Colorado stream chemistry.

While this is an oversight hearing, the formal hearing news releases urged Congressional consideration of legislation this year. Consequently, before leaving our discussion of acid rain, we would like to review the WRC position on acid rain legislation.

To date, acid rain research in the Western States has been much more modest than that in the East, but it has not identified any serious acid precipitation problems such as appear to exist in the Northeast. Although some isolated surface waters in the West have been identified as potentially sensitive, no confirmed adverse effects attributable to rainfall acidity have been reported. A number of factors contribute to the difference between the Eastern and Western regional situation: First, there are fewer major emission sources in the West, and they are widely distributed geographically. Second, most existing Western coal-fired stationary sources are already subject to the nation's most stringent emission limitations. Only about three percent of the sulfur dioxide emissions produced by coal-fired utilities in the United States is generated in the 11 Western States. Third, most western sources use low-sulfur fuels. The sulfur content per million BTU's has a direct impact on total SO_2 emissions. Fourth, the drier climate of the West results in less acid formation in the atmosphere. Fifth, much of the West has a typically alkaline soil which provides buffering capacity with respect to acidic reactions.

The Western Regional Council believes regional variations and state flexibility must be taken into account if Congress legislates to improve controls to reduce acid precipitation. Initial control efforts should be applied to both stationary and mobile sources in regions where significant acid precipitation problems exist (or where damage has occurred). Sources should be permitted use of the most cost effective methods available to achieve emission reductions. Future emission reductions should be implemented in a program of several phases and should be defined in response to research results. The costs of emission reductions should not be spread beyond the individual source through a national fee or tax approach. Caps on emissions should not be imposed.

The Western Regional Council believes that a program aimed at controlling acid precipitation and alleviating its adverse effects must be carefully structured to address the regional nature of the problem and must be reasonably implemented to ensure that control measures produce benefits corresponding to their costs.

The Western Regional Council advocates continued accelerated research to better understand the cause and effect of acid precipitation and believes research results should be the basis upon which control measures are designed. Overall costs of reductions in emissions to reduce acid precipitation are estimated in the billions of dollars. No major new legislative program should be implemented without an understanding of its benefits and a reasonable connection between costs and benefits. To the extent that controls are phased corresponding to research results and to the extent that sources are permitted flexibility in achieving emission reductions, the costs can be minimized. Major initial reductions in sulfur dioxide emissions from coal fired power plants can be achieved through coal washing, fuel blending, or use of low sulfur fuels, without technological controls which are expensive to install and just as costly to operate. Sources should be provided the flexibility to decide how best they can meet emission limitations at the lowest possible cost. Federal requirements should not dictate technological means of achieving emission reductions; state flexibility in structuring the program of emission reductions should be encouraged.

Western coal fired power plants are already being required to install technological controls at enormous expense. These controls were imposed despite the relatively lower emission levels in the region due to use of low sulfur fuels. Electrical users in the West are already paying for these controls and their operation and maintenance. These costs have been borne by the utilities and their customers, as those costs are likewise borne by sources in other regions which have been required to reduce emissions. We can see no equity in proposals to spread the costs of emission reductions beyond the individual source. We oppose a national fee or tax on utilities, consumers, fuel or other proposals that would shift the financial burden from the polluter.

Various proposals to address the problem of acid precipitation have included a cap on emission levels. At any one time there are factors which will influence the levels of emissions beyond control measures. Levels of consumption will fluctuate with weather patterns, fuel costs, conservation practices and other factors. Plant operations themselves and specific industry circumstances can dramatically influence the emission levels for any one year or time. We therefore suggest emissions caps not be included in legislation.

Finally, any program of reductions should take proper cognizance of control steps being taken or planned by existing sources in compliance with current regulations.

We will be glad to provide further information regarding specific acid rain legislative proposals upon request.

We would now like to discuss an issue of air quality in parks raised in the hearing announcement, and a subject raised by previous witnesses -- visibility.

The WRC supports the concept of protecting visibility in special national parks. After analyzing the evolving visibility program of the Environmental Protection Agency, however, we have concluded that there does not currently exist a sufficient understanding of visibility impairment attributable to man-made pollution sources to make possible a coherent regulatory program. EPA admits that the state of visibility monitoring and modeling is inadequate to permit rational implementation of its visibility protection program. It is essential that Congress provide EPA adequate time for better understanding of the causes of visibility impairment and the relationship between causes and the effects perceived by human observation.

A goal of the visibility program as stated in the Clean Air Act is to prohibit _any_ visibility impairment. A strict interpretation of this language could lead to a determination that even the slightest impairment -- measurable by instrumentation but undetectable to the human eye -- may not be allowed. Such an interpretation could lead in the extreme to a banning of automobiles from national parks. The WRC supports having the visibility program focus on _significant_ existing and future visibility impairments rather than on "any" visibility impairment at all. In determining what constitutes "significant impairment", factors to be considered should include effects on visibility experienced by visitors to the area; geographical extent, intensity, duration, frequency and time of visibility impairment; and how these factors correlate with visitors' use of the area.

In establishing the visibility program in 1977, Congress understood the need to limit the program to areas _within_ certain Class I areas. However, EPA, in writing regulations, went beyond the expressed intent of Congress by regulating "integral vistas", or areas of land outside, but visible from within, the Class I areas.

With hundreds of such integral vistas proposed for visibility protection by the National Park Service, the potential effects on western energy and minerals development and other activities are staggering. In an extreme example, for instance, one proposed vista is California's coastal range, as seen from the Class I area which includes Mount Whitney, 175 miles away. This one vista sweeps a wide arc of the center of California under visibility provisions intended by Congress to apply only within the federal Class I area. To remedy such burdensome overinclusion, Congress should amend the Clean Air Act to reassert that the visibility program apply only within the designated areas, and not apply to "integral vistas".

The visibility issue has its greatest impact in the West which has 120 out of the 188 proposed National Park Service "integral vistas". The WRC opposes the integral vista concept. It is not a part of the Clean Air Act and it would extend federal jurisdiction far outside the boundaries of Class I areas, frustrating state, local and private land use and siting decision-making roles. Expanding the visibility program through the device of integral vistas would have serious negative potential ramifications from western resource development. The protection of visibility over state and privately owned lands should be a state responsibility and not dictated by a federal land manager of a nearby or remote Class I area. The Clean Air Act should be amended to clarify that the visibility protection program is intended to protect visibility only "within" Class I areas.

In conclusion, we would like to briefly review and summarize our statement.

First, recent research and scientific data conclude that dramatic improvements have been achieved in air quality, including sulfur emissions and concentrations, in the West. Such emissions will continue to decline with the result that air quality in the West, including in our national parks, will continue to improve.

Second, while there is still insufficient research on acid deposition in the West, scientists and researchers are now focusing significant research efforts in the western region. Care should be taken in reviewing research reports to assess the actual data rather than merely a report author's or media summary conclusion. Research that has already been completed shows a notable lack of any scientific evidence of acidic deposition damage in the West, including in national parks in the West.

Third, if Congress considers legislation to improve controls to reduce acid precipitation, regional variations, as we have previously described, and state flexibility must be taken into account. Initial control efforts should be applied to both stationary and mobile sources in regions where significant acid precipitation problems exist or damage has occurred. Sources should be permitted use of the most cost effective means of emission reductions. Future emission reductions should be implemented in a program of several phases and should be defined in response to research results. Costs of emission reductions should not be spread beyond the source through a national tax or fee. Caps should not be imposed.

Fourth, visibility protection should apply within Class I federal areas, including national parks designated as Class I areas. However, such provisions should be limited to apply to effects only within such mandatory Class I federal areas. The concept of "integral vistas" should be repudiated.

We sincerely appreciate the interest of this Subcommittee in our national parks in the West and the opportunity to provide the Western Regional Council's unique western perspective to your review of air quality in national parks. We will be pleased to respond to any related questions or provide additional information.

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APPENDIX II

TUESDAY, MAY 21, 1985

ADDITIONAL MATERIAL SUBMITTED FOR THE HEARING RECORD

Boundary Waters Canoe Area Wilderness and Voyageurs National Park in Minnesota

Over the past decade, the study of air quality has become extremely sophisticated. The Federal Clean Air Act has been a vital catalyst in developing and refining what we know about the air that surrounds us. With the wealth of air quality research and study underway or already completed, the question arises as to how we make best use of the data available in crafting policy. Over the past four years this has become a real problem in the debate on acid rain. Whenever attempts are made to draw conclusions from the present data on acid rain the cry goes up for more study. Are we leading ourselves into the situation where we will continually study and debate the problems, so that when a course of action is finally taken we find no resources left to save?

This continued hesitancy exposes important national conservation units to continual risk from the varied assaults of air pollution.

In my own state of Minnesota, Voyageurs National Park (VNP) and the Boundary Waters Canoe Area Wilderness (BWCAW) are national resource treasures known for their pristine lakes, rugged geology and varied fish and wildlife. Yet those same physical and biological characteristics that make these areas a source of awe and wonder also make them susceptible to damage from air pollution. Over the past six years, I have seen the data that is continuously being collected in these areas. The picture it paints is a cause of concern. The dominant tree species of the VNP and BWCAW, the white pine and aspen, are particularly sensitive to sulfur dioxide emissions with most VNP-BWCAW surface waters having a poor buffering capacity. Perhaps most discouraging has been the finding that mercury levels, which increase as lakes acidify, are already high in lakes in and near the VNP-BWCAW, exceeding as much as 5 times the Food and Drug Administration's consumption limits. If allowed to continue, the implications of this on tourism and such fish predator species as the bald eagle and the osprey, would be devastating.

VNP and the BWCAW are in a region comparable in vulnerability to others that have already been severely affected by acid deposition in Europe and North America. Yet air quality studies in the region continue to go forth with little effort focused on damage mitigation. At present, there are at least 12 studies underway on some aspect of air quality problems of the VNP-BWCAW area. Will VNP and the BWCAW begin to look like some of Maine's forests; or worse yet, Germany's Black Forest before we begin to see action? Air pollution impacts on such ecosystems as the BWCAW and VNP are not a short-lived phenomena but accumulate to wear down the ecosystem's resistance to attack. Once the system is degraded and the white pines and aspen die out, how long will it take to bring the trees and the fishery back? No one knows. But I do know if we don't act soon to control air pollution, whole regions of our nation will suffer from an ecological disaster.

STATEMENT
SENATOR GEORGE J. MITCHELL
HOUSE SUBCOMMITTEE
NATIONAL PARKS AND RECREATION
MAY 21, 1985

Mr. Chairman, I want to thank you for inviting me to testify before your subcommittee today on a subject of great interest to me, the effects of air pollution on Acadia National Park in Maine.

Before I begin my testimony I want to briefly digress and express my strong support for Acadia park legislation which is pending before the subcommittee. S.720, which I introduced with my Senate colleague Bill Cohen, and H.R.1685, which Olympia Snowe and Jock McKernan have introduced here in the House, would establish congressionally mandated boundaries for Acadia.

The need for this legislation arises from a historical fact which has resulted in decades of controversy: Acadia was created by private donations of land in the early years of this century and its charter, while authorizing further expansion of the park through donations, does not authorize acquisition of land through purchase.

This combination, the inability to purchase desirable land for inclusion in the park and the ability to accept donations with little constraint, poorly serves the interests of local towns and residents or the preservation of the park's unique resources. The legislation before this subcommittee would rectify this problem and I hope that you will give the bill your attention and support.

Acadia was the first park created east of the Mississippi river. Since 1916, Acadia has been an important natural and recreational resource for state and local residents, and for millions of people from other states and nations who enjoy the park each year. In 1984, the park service recorded over 4 million visitors to Acadia.

The natural resources of Acadia, its spectacular beauty, and its unique coexistance with fishing villages and towns which were established with the beginnings of Europian settlement on the North American continent, combine to make Acadia an experience unlike any other in our nation.

Acadia is a nesting site for almost 150 bird species. Over 320 species of birds have been seen in the park. Just last May, seven peregrine falcons were reintroduced to the park as part of the effort to reestablish a breeding population of this bird on the east coast.

Clearly Acadia is a national treasure worthy of protection.

Yet, as you heard during yesterday's testimony by Dr. Janet Anderson, there is new evidence of possible negative impacts of acid rain on the waters of the park. A recent study of this problem by the University of Maine and the College of the Atlantic reports that the average ph of rainfall in the park is between 4.3 and 4.5. This level is more than expected for a coastal area.

Small brooks show the most marked effects of this acidity, especially during spring snow melt. The study indicates that the largest lakes in the park are in good condition today. These lakes may be threatened if acidic precipitation continues unabated. In addition, a number of acid fog events occurred last summer in the area of the park.

High levels of ozone has also been recorded in the park recently. In 1983, ozone levels in the park exceeded the state standard of .08 parts per million 101 times and remained high in 1984, exceeding the state standards 88 times. Ozone levels above state standards often cause eye and respiratory irritation. The elderly, small children, and those engaged in outdoor activities are particularly susceptible to these effects. In addition, ozone levels of about .05 parts per million have serious effects on trees, particularly the White pine.

The evidence of damage of Acadia from air pollution, particularly acid rain, is one more example of a growing problem. There can be no serous doubt that acid precipitation has damaged our nation's lakes and streams. Also, studies increasingly indicate that acid rain may indeed be causing forest damage in the United States. And we are beginning to see evidence of human health damage that is associated with current levels of acidic compounds.

On January 24th of this year I again introduced comprehensive legislation to deal with the problem of acid rain. This bill requires a ten million ton reduction in sulfur dioxide emissions within ten years after enactment.

While Congress has failed to act on acid rain legislation, the continuing accumulation of scientific knowledge makes me confident that we will eventually have a meaningful acid rain control program. There is no question as to whether we will act, only a question as to when.

There may be disagreement as to the details of a control strategy. This is to be expected. But further postponement of debate and action on this issue will result in increased environmental damage, increased levels of controls, and, perhaps, in increased costs of a control strategy.

In conclusion, I am pleased to have had an opportunity to share my views on the importance of Acadia National Park and to express my concern over increasing evidence of damage to the park from air pollution.

I also look forward to working with the subcommittee as you consider legislation to establish a permanent boundary for the park.

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SENATOR MAX BAUCUS

TESTIMONY BEFORE THE HOUSE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION

MAY 21, 1985

Mr. Chairman, I commend you for calling these two days of hearings to gather testimony on air pollution in our national parks.

National Parks are our special places. They are our cathedrals.

But of those parks, there is a core of parks that make up the crown jewels of our national park system.

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I am referring to parks such as Glacier National Park and Yellowstone National Park in my state; Yosemite, Rocky Mountain and Cascade national parks. These parks are world renowned. They represent the frontier that has made this country great.

Each year, millions of visitors travel to these parks to enjoy their serenity, their solitude, their natural splendor and their wildlife.

These areas deserve special protection.

The Clean Air Act recognizes this. Areas such as national parks are Class I airsheds. Stringent standards regulate their air quality.

These stringent standards are met to insure against "significant deterioration."

But recently, I have become concerned that these special standards may not be enough.

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These standards protect against immediate or localized pollutants but may not do the job of protecting national parks from pollutants coming from long distances.

I am referring to acid rain.

"Acid rain" is nothing more than air pollution that travels a long distance. Nitrous oxides forms nitric acid or contributes to ozone formation. Sulfur dioxide forms sulfuric acid.

Much of the debate to date has focused on sulfur emissions. Most of the sulfur pollution comes from existing coal fired power plants. Sulfur dioxide control is a major concern both in the east, where the problem is severe, and in the west where continued diligence is needed.

But in the west, other pollutants have been identified.

The World Resources Institute recently completed a study of acid rain in the west. This study concluded that nitrous oxide emissions were the major concern in the west.

This study further concluded that our most vulnerable areas were our national parks and our wilderness areas.

Unlike the east, though, where acid rain is causing serious damage, there may still be time if we act promptly to avoid serious problems.

We need action now. But we need a different solution.

- In the west, NOx is a major concern. Recent reports on acid rain damage in Germany caused by NOx, underscore the need to do more to control NOx.
- More stringent NOx controls need to be considered for automobiles, trucks and stationary sources.

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* Our greatest concern in the west about sulfur dioxide pollution is a copper smelter in Mexico. This smelter could come on line with little or no pollution controls. We need to push for pollution controls on this smelter, but also reconsider how we are regulating our own copper smelters. The Western Governors' Association has taken a position opposing the extension of non-ferrous smelter order deadlines. It is time for Congress to reconsider this issue.

* The New England states have relied on transboundary pollution abatement provisions of the Clean Air Act to address pollution sources in other states. But this has not been successful. Congress needs to take steps to make Section 126 of the Clean Air Act workable, or we won't be able to protect national parks. Perhaps we need to look at groups of both mobile and stationary sources rather than looking at a single source, as is currently required.

* The Clean Air Act does a good job of controlling pollution from new sources.

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Percentage reduction requirements are unfair to the west. They have kept emissions low, but at a tremendous cost. There is a need to set standards to permit pollution to reach these standards in the most cost effective manner. At the same time, we need to take a hard look at the current emphasis on new pollution sources. Perhaps existing source standards need to be promulgated.

Senator Hart and I are planning field hearings to gather testimony on acid rain in the west.

I hope to hold hearings in Yellowstone, Rocky Mountain National Parks, and perhaps other areas throughout the west to learn more about the problem.

Once again, Mr. Chairman, I commend you for holding these hearings and look forward to working with you to resolve this critical issue.

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STATEMENT OF CONGRESSMAN HENRY A. WAXMAN
CHAIRMAN
HEALTH AND ENVIRONMENT SUBCOMMITTEE
OF THE COMMITTEE ON ENERGY AND COMMERCE

BEFORE THE
SUBCOMMITTEE ON PUBLIC LANDS AND NATIONAL PARKS
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS
MAY 21, 1985

MR CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE, THANK YOU FOR THE OPPORTUNITY TO OFFER TESTIMONY ON ONE OF AMERICA'S MOST SERIOUS ENVIRONMENTAL PROBLEMS, ACID RAIN. THOSE WHO HAVE FOLLOWED THIS ISSUE EVEN CASUALLY OVER THE PAST SEVERAL YEARS KNOW THAT WE FACE SERIOUS AND WIDESPREAD ACID DAMAGES UNLESS WE MOVE QUICKLY TO REDUCE THE SULFUR DIOXIDE AND NITROGEN OXIDES POLLUTION THAT CAUSES ACID RAIN.

EVIDENCE CONTINUES TO MOUNT THAT IN IGNORING THE ACID RAIN PROBLEM WE RISK AN ENVIRONMENTAL AND ECONOMIC TRAGEDY OF HISTORIC PROPORTIONS -- NOT JUST IN NEW ENGLAND BUT OVER LARGE PARTS OF OUR COUNTRY.

> IN A NATIONAL SURVEY IN 1982 THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) FOUND THAT LAKES IN LARGE PARTS OF NEW ENGLAND, THE UPPER MIDWEST, THE MOUNTAIN WEST, AND THE SOUTHEAST ARE VULNERABLE TO ACID RAIN, BECAUSE THEIR SOILS ARE LOW IN NATURAL MINERALS, SUCH AS LIME, THAT CAN

NEUTRALIZE ACIDS. THE REGION WITH THE LARGEST SENSITIVE AREA WAS NOT NEW ENGLAND BUT THE SOUTHEAST WHERE, BY UNHAPPY COINCIDENCE, ACID-FORMING SULFUR DIOXIDE EMISSIONS HAVE INCREASED MORE THAN FIVE-FOLD SINCE 1950.

THE WORLD RESOURCES INSTITUTE RECENTLY PUBLISHED A NEW STUDY WARNING THAT LARGE AREAS OF THE WEST FACE THE THREAT OF SERIOUS ACIDIFICATION DAMAGES.

LAKES ARE BUT A SMALL PART OF THE PROBLEM. FORESTS ARE SHOWING SIGNS OF A PRECIPTIOUS UNEXPLAINED DECLINE OVER LARGE AREAS OF THE EASTERN U.S., AND ACID RAIN, ALONG WITH OTHER AIR POLLUTANTS, LEADS THE LIST OF SUSPECTED CAUSES.

ONCE LUSH SPRUCE AND FIR FORESTS ON EASTERN MOUNTAINS, SUCH AS CAMEL'S HUMP IN VERMONT AND MOUNT MITCHELL IN NORTH CAROLINA, ARE NOW LITTERED WITH DEAD OR DYING TREES -- RESEMBLING BATTLEFIELDS MORE THAN FORESTS. TREES ARE ALSO SUFFERING IN THE MIDWEST, ESPECIALLY IN THE HEAVILY POLLUTED OHIO RIVER BASIN, WHERE MUCH OF THE ACID RAIN IN THE EASTERN U.S. ORIGINATES. THE GROWTH OF ECONOMICALLY IMPORTANT PINE SPECIES, VITAL TO THE ECONOMY OF MANY STATES IN THE SOUTHEAST, HAS DECLINED DRAMATICALLY IN THE PAST DECADE.

THE WARNING SIGNS COULD HARDLY BE MORE CLEAR. THOSE WHO LABEL SUCH CONCERN ALARMIST HAVE ONLY TO CONSIDER THE ACID DEVASTATION THAT HAS ALREADY BEFALLEN CENTRAL EUROPE AND SCANDANAVIA. IN SWEDEN AND

NORWAY MORE THAN 30,000 LAKES HAVE BEEN ACIDIFIED. IN WEST GERMANY THE GOVERNMENT REPORTED IN 1984 THAT FULLY ONE HALF OF THE NATION'S TREES HAVE BEEN DAMAGED BY AIR POLLUTION. OFFICIAL SKEPTICISM OVER ACID RAIN IN THESE COUNTRIES, AS IN MOST OF WESTERN EUROPE, HAS GIVEN WAY TO PUBLIC ALARM AND GOVERNMENT ACTION. IT IS TIME THAT THE U.S. FOLLOWED SUIT.

MORE THAN THREE YEARS AGO AMERICA'S MOST PRESTIGIOUS SCIENTIFIC ORGANIZATION, THE NATIONAL ACADEMY OF SCIENCES (NAS) , UNDERTOOK A MAJOR STUDY OF THE ACID RAIN PROBLEM. THE NAS COMMITTEE UNAMBIGUOUSLY RECOMMENDED "PROMPT TIGHTENING OF RESTRICTIONS ON ATMOSPHERIC EMISSIONS," AFTER WARNING THAT "CONTINUED EMISSIONS OF SULFUR AND NITROGEN OXIDES, IN THE FACE OF CLEAR EVIDENCE OF SERIOUS HAZARD TO HUMAN HEALTH AND TO THE BIOSPHERE, WILL BE EXTREMELY RISKY FROM A LONG TERN ECONOMIC STANDPOINT AS WELL AS FROM THE STANDPOINT OF BIOSPHERE PROTECTION."

NUMEROUS STUDIES AND SCIENTIFIC PANELS HAVE SINCE REAFFIRMED THE ACADEMY'S RECOMMENDATIONS. IN FACT, WHEN PRESIDENT REAGAN -- WHO DID NOT LIKE THE CONCLUSIONS OF THE NAS STUDY -- ASKED HIS WHITE HOUSE SCIENCE ADVISOR, GEORGE KEYWORTH, TO CONVENE A GROUP OF SCIENTISTS TO OFFER AN INDEPENDANT REVIEW OF THE ACID RAIN ISSUE, THE RESULT WAS A RESOUNDING AFFIRMATION OF THE NAS CALL FOR CONTROL ACTION. THE ADMINISTRATION FOUGHT FOR MORE THAN A YEAR TO SUPPRESS THIS REPORT WHILE WORKING AGAINST ACID RAIN CONTROL IN THE CONGRESS.

DESPITE THE UNAMBIGUOUS ADVICE FROM REAGAN'S OWN SCIENCE ADVISOR, DOLLARS AND CENTS. WHAT WE CANNOT AFFORD IS THE COSTS OF NOT TAKING ACTION.

THESE COSTS GO FAR BEYOND EVEN THE LOSS OF PRICELESS LAKES AND ECONOMICALLY VITAL FORESTS. ACCORDING TO THE U.S. EPA, SULFUR DIOXIDE, THE CENTRAL CAUSE OF ACID RAIN, IS A PROVEN THREAT TO HUMAN HEALTH, AGRICULTURAL PRODUCTIVITY AND MAN-MADE MATERIALS. THE HEALTH IMPACTS ARE NOT EASILY QUANTIFIED. BUT WE KNOW THAT THEY ARE ESPECIALLY SERIOUS FOR THOSE WITH CHRONIC RESPIRATORY AILMENTS SUCH AS ASTHMA, BRONCHITUS, OR EMPHYSEMA.

UNIVERSITY OF WYOMING ECONOMIST THOMAS CROCKER HAS ESTIMATED THAT ACID RAIN CAUSES BILLIONS OF DOLLARS IN DAMAGE EACH YEAR TO BUILDING MATERIALS, BRIDGES, AUTOMOTIVE PAINTS, AND OTHER MAN-MADE SURFACES. IN ADDITION, SCIENTISTS HAVE ESTIMATED THAT MORE THAN TWO BILLION DOLLARS IN AGRICULTURAL PRODUCTS ARE LOST EACH YEAR AS A RESULT OF AIR POLLUTION. ALTHOUGH IT HAS NOT BEEN POSSIBLE TO SEPARATE THE CONTRIBUTION OF VARIOUS POLLUTANTS, MOST EXPERTS BELIEVE THAT SULFUR DIOXIDE IS RESPONSIBLE FOR A SIGNIFICANT SHARE OF THIS DAMAGE.

THERE IS LITTLE DOUBT THAT ACID RAIN CONTROL IS A STUPENDOUS BARGAIN WHEN CONTRASTED WITH THE COSTS OF CONTINUING TO DO NOTHING. WE IN THE CONGRESS MUST FIND AWAY TO AVAIL OURSELVES OF THIS BARGAIN WHILE THERE IS STILL TIME.

ACID RAIN IS THE KIND OF REGIONALLY DEVISIVE ISSUE WHERE ACTION COULD BE MOST EASILY SECURED WITH THE HELP OF PRESIDENTIAL LEADERSHIP.

AND DESPITE UNDENIABLE EVIDENCE OF A GROWING THREAT TO OUR LAKES AND FORESTS, THE REAGAN ADMINISTRATION TENACIOUSLY CLINGS TO ITS "DO NOTHING" POLICY FOR ACID RAIN. OSTENSIBLY THIS POLICY REFLECTS A DETERMINATION THAT MORE RESEARCH IS NEEDED BEFORE WE KNOW ENOUGH TO TAKE CONTROL ACTION. IN FACT, REAGAN'S DECISION TO IGNORE THE ACID RAIN ISSUE, LIKE SO MANY OTHER ADMINISTRATION POLICIES, IS GROUNDED IN A SHORT-SIGHTED DESIRE TO PROTECT THE PROFITS OF A NARROW SECTOR -- IN THIS CASE UTILITIES AND COAL COMPANIES -- AT THE EXPENSE OF IMMENSE LONG-TERM ECONOMIC AND ENVIRONMENTAL COSTS.

WHEN REAGAN'S FIRST EPA ADMINISTRATOR, ANNE GORSUCH BURFORD, RESIGNED UNDER FIRE IN EARLY 1983, HER ACID RAIN POLICY WAS A MAJOR FOCUS OF PUBLIC CRITICISM. SEEKING TO QUIET THE STORM, REAGAN ANNOUNCED THAT ACID RAIN CONTROL WOULD BE A TOP PRIORITY FOR NEW ADMINISTRATOR WILLIAM RUCKELSHAUS. BUT MR. RUCKELSHAUS' WIDELY REPORTED EFFORT TO SECURE ADMINISTRATION SUPPORT FOR EVEN A MODEST ACID RAIN CONTROL EFFORT WAS A DISMAL FAILURE.

IT IS SADLY CLEAR THAT NEITHER EPA NOR AMERICA'S SCIENTISTS HAVE ANY VOICE IN OUR COUNTRY'S POLICY ON ACID RAIN. RATHER, IT IS DAVID STOCKMAN AND THE ACCOUNTANTS AT OMB WHO SET THE NATION'S ENVIRONMENTAL POLICIES. HEALTHY LAKES AND FORESTS FOR OURSELVES AND OUR CHILDREN, AND REDUCED INCIDENCES OF CHRONIC RESPIRATORY AILMENTS LIKE ASTHMA AND EMPHYSEMA ARE NOT BENEFITS WHICH CAN EASILY BE GIVEN A DOLLAR VALUE. SO OMB HAS CONCLUDED THAT ACID RAIN CONTROL IS NOT WORTH THE COSTS.

BUT THEY ARE BADLY MISTAKEN, EVEN FROM THEIR NARROW PERSPECTIVE OF

BUT IT IS CLEAR THAT WE WILL NOT SEE SUCH LEADERSHIP FROM THE REAGAN ADMINISTRATION. IT IS THEREFORE UP TO US IN THE CONGRESS TO MOVE THE ISSUE FORWARD.

WE CAME CLOSE TO ACHIEVING THIS GOAL LAST YEAR WHEN MINNESOTA CONGRESSMAN GERRY SIKORSKI TOOK THE LEAD ON A BOLD INITIATIVE TO FIND A WAY AROUND THE REGIONAL DIVISIVENESS THAT SO OFTEN SURROUNDS THE ACID RAIN ISSUE.

LIKE SEVERAL OTHER BILLS INTRODUCED LAST YEAR, SIKORSKI'S BILL WOULD HAVE DRAMATICALLY REDUCED -- BY FORTY PERCENT -- THE MILLIONS OF TONS OF SULFUR DIOXIDE AND NITROGEN OXIDES DUMPED INTO AMERICA'S AIR EACH YEAR. BUT THE SIKORSKI BILL WAS UNIQUE IN ONE KEY ASPECT. IT ACHIEVED ITS EMISSION REDUCTIONS WITHOUT IMPOSING A HEAVY BURDEN ON ANY STATE OR REGION'S ECONOMY, AND WITHOUT PUTTING MINERS OUT OF WORK.

THE 50 DIRTIEST POWER PLANTS IN THE COUNTRY, WOULD HAVE BEEN REQUIRED TO INSTALL POLLUTION CONTROL DEVICES TO DRAMATICALLY REDUCE THE MANY TONS OF ACID POLLUTION THAT THEY RELEASE EACH DAY. BECAUSE THE BILL RELIES UPON POLLUTION CONTROL TECHNOLOGY TO REDUCE EMISSIONS, RATHER THAN A SHIFT TO LOWER SULFUR COAL, APPALACHIAN MINERS OF HIGH SULFUR COAL WOULD SEE THEIR JOBS PROTECTED.

THE BILL ESTABLISHED A "TRUST FUND", SUPPORTED BY A SMALL NATIONWIDE ELECTRICTY FEE OF ONE MILL PER KILOWATT HOUR, TO PAY 90% OF THE COSTS OF BUILDING THE POLLUTION CONTROL EQUIPMENT. THE BALANCE OF THE CONSTRUCTION COSTS, AND THE COSTS OF OPERATING AND MAINTAINING THE

POLLUTION REMOVAL DEVICES, WOULD BE BORNE BY THE POLLUTING UTILITIES.

THE RATIONALE BEHIND THIS APPROACH IS STRAIGHTFORWARD. ACID RAIN IS A NATION PROBLEM -- THREATENING LAKES, FORESTS, AND THE PUBLIC HEALTH IN ALL REGIONS OF THE COUNTRY -- AND IT WARRENTS A NATIONAL SOLUTION. UNDER THE SIKORSKI BILL, ALL STATES WOULD CONTRIBUTE TO THE VITALLY IMPORTANT CONTROL EFFORT THROUGH A SMALL INCREASE IN ELECTRICITY RATES. BUT THOSE MOST RESPONSIBLE WOULD BEAR A LARGER SHARE OF THE COSTS.

THE RESULT WAS AN EFFECTIVE PROGRAM AFFORDABLE TO EVERY STATE. AFTER DETAILED STUDY THE CONGRESSIONAL OFFICE OF TECHNOLOGY ASSESSMENT PROJECTED THAT THE AVERAGE ELECTRICITY CONSUMER WOULD FACE A RATE INCREASE OF LESS THAN THREE PERCENT. EVEN IN THE MOST HEAVILY POLLUTING STATE, OHIO, WHERE THE DEMANDS OF CONTROL WOULD BE THE GREATEST, ELECTRICITY COSTS WOULD INCREASE BY ONLY SIX PERCENT -- ROUGHLY HALF OF THE COSTS WHICH RATEPAYERS WOULD BEAR IF OHIO WERE TO CLEAN UP ITS AIR WITHOUT THE HELP OF A TRUST FUND.

OVER 130 CO-SPONSORS ENDORSED THIS BILL LAST YEAR, A FAR GREATER NUMBER THAN FOR ANY OTHER ACID RAIN BILL. BUT THAT WAS NOT ENOUGH. I WAS DISAPPOINTED TO SEE THE SIKORSKI BILL DEFEATED BY A 10 TO 9 VOTE LAST SPRING IN OUR SUBCOMMITTEE ON HEALTH AND THE ENVIRONMENT. EVEN SO, THE CONTRIBUTION OF THIS LEGISLATION IS A LASTING ONE. IT HAS NOW BEEN DEMONSTRATED THAT PRACTICAL, AFFORDABLE APPROACHES ARE AVAILABLE FOR STOPPING ACID RAIN.

THIS YEAR WE WILL BE LOOKING CLOSELY AT THE SIKORSKI BILL, AND AT A VARIETY OF OTHER APPROACHES, AS WE SEEK TO DEFINE A CONTROL PROGRAM THAT WILL ATTRACT THE SUPPORT OF A MAJORITY OF THE HEALTH AND ENVIRONMENT SUBCOMMITTEE.

WE WILL BE WORKING VERY HARD ON THIS ISSUE BECAUSE OUR MOST IMPORTANT GOAL IS TO STOP THE ACID ASSAULT, AND WE ARE LOSING PRECIOUS TIME.

STATEMENT OF MARY LOU GRIER, ACTING DIRECTOR, NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR, BEFORE THE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION, HOUSE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, OVERSIGHT HEARINGS CONCERNING EFFECTS OF AIR POLLUTION ON RESOURCES OF THE NATIONAL PARK SYSTEM.

MAY 21, 1985

Mr. Chairman, I appreciate this opportunity to provide your Subcommittee with an overview of the National Park Service's efforts to understand air pollution effects on resources of the National Park System.

We know from our research efforts that air pollution can damage the resources that units of the National Park System have been created to protect. We recognize that this is a national issue not confined to parks, because parks have the same exposure to the effects of air pollution as the rest of the country and the world. All branches of government continue to wrestle with this question as a major national public policy issue.

We recognize our obligation to protect park resources, including clean air, has been established by statute. The National Park Service under its Organic Act administers all units of the National Park System so as "to conserve the scenery and the natural and historic objects and the wild life...unimpaired for the enjoyment of future generations." Enabling statutes for individual park units routinely supplement this "fundamental" resource protection purpose with specific protection purposes.

In addition, the Clean Air Act charges the Secretary of the Interior, as Federal Land Manager, with an "affirmative responsibility" to protect from the adverse impacts of air pollution the forty-eight units of the National Park System designated "class I" under that act, namely, all national parks over 6,000 acres and wilderness areas over 5,000 acres which were in existence on August 7, 1977. Under the Clean Air Act, the Secretary of the Interior participates in the review of major new sources of air pollution proposed for location in areas where the air is cleaner than the National Ambient Air Quality Standards, in order to determine whether a proposed source will have an adverse impact on the resources of a "class I" park unit. The Clean Air Act also requires the Environmental Protection Agency and the States to consult with the Secretary as a general rule concerning implementation measures affecting lands under the Secretary's jurisdiction, and in specific ways on issues such as "redesignation" of Federal lands and visibility protection of mandatory "class I" Federal areas. Through these and other provisions, we attempt to fulfill one of the purposes of the Clean Air Act's "Prevention of Significant Deterioration of Air Quality" program: "to preserve, protect, and enhance the air quality" of special areas including the units of the National Park System.

The National Park Service takes these Congressionally-mandated responsibilities very seriously. To carry them out, we have developed a number of programs that address air pollution concerns, and we are extremely proud of our efforts to meet the requirements of the law.

Overall responsibility for the Service's air quality programs is in the Air Quality Office, an office created in 1977, with an FY 85 budget of $3.9 million, and with a professional staff of eighteen people who have significant scientific, technical, and regulatory expertise. The responsibilities of this Office include assessing the condition of park resources and air quality; identifying and assessing existing air pollution impacts and causes; integrating air resources management into Service operations and planning; developing interpretive materials for park use; participating with Federal, State, and local agencies in development of regulatory programs; remedying existing resource impacts; and preventing future impacts to units of the National Park System from man-made air pollution.

The Air Quality Office has been monitoring air quality and visibility in units of the National Park System since 1978. The present monitoring program, including quality assurance of data, involves sulfur dioxide monitors at 11 parks, ozone monitors at 19 parks, total suspended particulate monitors at 16 parks, nitrogen dioxide monitors at two parks, a hydrogen sulfide monitor at one park, fine particulate monitors for visibility at 28 parks, teleradiometers for visibility at 29 parks, and cameras for visibility at 35 parks.

In 1982, the Air Quality Office launched a major "Biological Effects Program" to study the effects of air pollution on vegetation. This program includes air pollution effects surveys, sensitivity screenings, trace element surveys, and ecological surveys, with activities in FY 85 in approximately thirty-five parks. As with the Office's scientific and technical activities in general, much of the biological effects research is performed by recognized scientific experts through contracts with universities, scientific laboratories, and other Federal agencies. Other than our efforts, there is little research on air pollution impacts on the native vegetation of parks, since the research of others has focused primarily on economic resources, such as crops and timber.

The Air Quality Office runs two additional technical programs. Since 1979, the Office has maintained expertise on pollution control technology for analyzing permit applications for proposed new facilities that have the potential to affect park areas. Also since 1979, the Office has been engaged in applying and developing various models for tracing and predicting the movement and the concentration levels of air pollution. For example, the Office has developed a state of the art, long-range transport model to estimate sulfur dioxide and sulfate concentrations within much of the eastern United States, including

Shenandoah, Acadia, Great Smoky Mountains, and Mammoth Cave National Parks.

In addition to the Air Quality Office, the Service has two other programs that address the effects of air pollution. As part of the eleven-agency, ten-year National Acid Precipitation Assessment Program, the Service runs two long-term research efforts to study the effects of acid deposition on cultural and on aquatic resources, funded in FY 85 at $725,000 and $511,000, respectively.

Our involvement in the cultural resource acid precipitation research program stems from our responsibility for the preservation of much of the cultural heritage of our country, exemplified by national symbols like the Jefferson Memorial, historic buildings like Independence Hall, statuary such as the Gettysburg monuments, and archaeological resources like the prehistoric pueblo dwellings at Mesa Verde National Park. More than 11,000 historical buildings and monuments are within the 230 cultural units of the National Park System. In addition, there are an estimated 250,000 structures listed on the National Register of Historic Places. Since 1982, the Service has begun twenty acid precipitation research projects of three general types, namely, (1) inventorying and monitoring the cultural resources most vulnerable to air pollution damage, (2) studying the deterioration process of sensitive cultural materials such as marble, limestone, mortar, and bronze, and (3) evaluating methods to mitigate the effects of air pollution. To establish the causal relationship between air pollution and cultural resource damage, the Service now operates two long-term monitoring sites, one at Independence National Park and the other at Mesa Verde National Park, that assess both environmental factors and material deterioration. We plan to add an additional long-term site each year.

Our research effort on the effects of acid precipitation on aquatic sytems, also begun in 1982, now involves a wet deposition monitoring program in 27 areas, and watershed research projects in four national parks---Rocky Mountain, Sequoia/Kings Canyon, Olympic, and Isle Royale. The Service is cooperating with several others, including the U.S. Geological Survey, to study parks in the Rocky Mountain Region, the southern Appalachians, and the Sierras. The Great Lakes Basin parks are being studied to determine how acid deposition correlates with water quality. Northwestern lakes and streams in Mt. Rainier and North Cascades National Parks are being monitored for effects from acid precipitation.

We believe that our programs to address air pollution effects are excellent. We have assembled competent personnel, emphasized quality research with proper peer review, and established in-park monitoring programs to establish baseline data and to detect changes in air pollution levels over time. We have made substantial progress over the last seven years. We recognize, however, that our research and monitoring efforts to date have been limited to selected park units, and our work continues as part of the national research effort on this question.

The results of our research and monitoring reveal serious air pollution problems in many units of the National Park System. We previously have provided the Subcommittee staff detailed summaries of the effects of air pollution on vegetation, wildlife, visibility, cultural resources, and aquatic resources. We are submitting these summaries again today for the hearing record.

Our monitoring has revealed ozone pollution levels in remote park areas higher than the National Ambient Air Quality Standard for ozone and surprisingly high levels of sulfur dioxide in some parks. Further, our monitoring has shown that, in addition to natural sources of visibility impairment, there are varying degrees of visibility impairment from man-made pollution in virtually all monitored parks almost all the time.

Our research on vegetation in the last three years has found ozone injury, which appears as characteristic spots on leaves, in virtually every park surveyed, raising the possibility of species loss and forest decline. We have found the decimation of lichens in two urban parks, and elevated levels of sulfur and heavy metals in vegetation in several parks.

With respect to cultural resources, qualitative evidence demonstrates that air pollution accelerates the deterioration of cultural materials. These effects are cumulative and in most cases irreversible. Although our research efforts are recent, it is already evident that air pollution may be a very great threat to the man-made environment.

Our research on aquatic resources will establish the long-term effects of airborne pollutants on park watersheds, including lakes, streams, and the associated riparian systems. We will also examine the influence of different management activities in protecting aquatic resources from acidification. We already know that certain park streams and lakes are sensitive to acid deposition.

I have given you an overview of our efforts to date, Mr. Chairman. As you can see, these are complex issues, requiring great scientific effort and expertise, and issues that do not lend themselves readily to simple solutions. I have brought several National Park Service scientists and technical experts with me today, as well as Superintendents from ten parks, to answer any questions you may have. At this point, I shall ask Dr. Richard Briceland, Associate Director for Natural Resources, to assist the Superintendents and me by referring your questions that can best be answered by our technical staff to the appropriate expert.

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Air Quality Office
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Dr. Richard McNider	Research Scientist, K. E. Johnson Environmental and Energy Center University of Alabama
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STATEMENT BY
CONGRESSMAN TONY COELHO
BEFORE THE HOUSE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION
MAY 21, 1985

Mr. Chairman, it is becoming increasingly evident that the San Joaquin Valley of California, in which my district is located, and the adjacent Sierra Nevada Mountains, have not escaped the affects of air pollution.

Research scientists within Sequoia and Kings Canyon National Parks have been conducting studies on the affects of ozone and acid rain within these two National Parks. The results of these studies reveal that the pine trees in Sequoia and Kings Canyon National Parks are in the early stages of air pollution damage. They noted that air pollution can cause an increase in the rate of mortality amoung pine trees and stunt the growth of surviving pine trees and that this is what happened to the pine trees of the San Bernardino National Forest, which borders the Los Angeles basin.

Most visitors are aware of air pollution in the Parks only after they hike to Panorama Point. Expecting to enjoy its breath taking view extending from the crest of the 14,000 foot peaks of the Sierra Nevada Mountains to the bottom of the deepest canyon in the United States, all they are presented with is a view of a forest of pine trees engulfed in a sea of smog.

Researchers in these two Parks have found that during the summer, thunderstorms tend to bring with them a higher than normal amount of acidity which rains down on these National Parks. The results of studies conducted by these researchers show that the soils of the Sierra Nevada Mountains appear to be exceedingly susceptible to acid rain because the granite bedrock underlying the soil limits the soil's ability to absorb these pollutants. As a result, this acidic water percolates into the pristine lake and streams of these National Parks, spoiling the natural beauty that the American public mandated our government to preserve for present and future generations.

The San Joaquin Valley, and its productive agriculture, are not immune from the air pollution that is affecting Sequoia and Kings Canyon National Parks. Researchers at the University of California, Riverside have found that ozone, a component in air pollution, has dramatically reduced agricultural crop yields in the San Joaquin Valley. The San Joaquin Valley, situated in the heart of California, is bordered on two sides by the Sierra Nevada Mountains. This valley is paramount to California's agricultural economy by producing over 50 percent of all crops grown in California and making up 5 percent of the total U.S. agricultural output.

The agricultural productivity of the San Joaquin Valley can be seen in the abundance and variety of crops produced there. Of the three leading agricultural crops grown in California, 92 percent of the cotton crop, almost 100 percent of the Thompson Seedless crop, and 95 percent of the alfalfa crop are grown in the San Joaquin Valley. The impact that air pollution has had on the productivity of these three crops in the San Joaquin Valley has been devastating. Cotton yields have been reduced by 15 to 20 percent, Thompson Seedless yields have declined by an amazing 25 percent, and alfalfa production has fallen by 5 percent.

In 1984, the effects of air pollution on San Joaquin Valley agriculture resulted in a reduction of $194-210 million in cotton income, $130 million in Thompson Seedless grapes income, and a reduction of $16 million for alfalfa production. The total loss in productivity for these three crops alone totals to an incredible $330-356 million

Farmers are not the only ones who are losers due to air pollution in the San Joaquin Valley. The California Department of Food and Agriculture has calculated that, as a result of the reduction of these three crops in the San Joaquin Valley, the U.S. economy lost $1.3-1.4 billion dollars---all on account of air pollution in the San Joaquin Valley. This was due to the multiplier effect of the production of agricultural commodities.

We can no longer overlook air pollution as a byproduct of a growing economy, not when it is robbing our farmers of millions of dollars and destroying the natural beauty of our National Parks. Therefore Mr. Chairman, I welcome this hearing as a step in the right direction in emphasizing to Congress and the American people how increasingly damaging air pollution is to California agriculture and the need to stop the destruction it is causing to our Nation's Parks.

United States Department of the Interior

OFFICE OF THE SOLICITOR
WASHINGTON, D.C. 20240

SEP 20 1985

In Reply Refer To:
NPS.CW.0264

Memorandum

To: Director, National Park Service

From: Associate Solicitor

Subject: Protection of National Park System Units from the Adverse Effects of Air Pollution

This memorandum is written in response to your request for an analysis of the legal authority of the Department of the Interior (DOI) to protect units of the National Park System (NPS) from the adverse effects of air pollution.

Since its creation in 1916 the National Park Service has been charged with the responsibility of managing NPS units in such a way as to "conserve the scenery and the natural and historic objects and the wildlife therein . . . ." (See 16 U.S.C. §§ 1, 3.) That responsibility was reaffirmed in 1978. (See id. § 1a-1.) This memorandum examines the legal tools to carry out that responsibility insofar as it entails the protection of NPS units from the adverse effects of air pollution.

By and large, air pollution which adversely affects NPS units has its source outside those units and, therefore, outside the area of DOI's general park regulatory jurisdiction. Accordingly, the authority of the Secretary of the Interior to address the harmful effects of air pollution within NPS units largely depends upon the extent to which existing law empowers the Secretary to regulate, control or otherwise affect air polluting activities outside NPS units which create those harmful effects within them.

CLEAN AIR ACT

The clearest grant of authority to the Secretary to protect NPS units from the harmful effects of air pollution generated outside those units is contained in the Clean Air Act (CAA). (See 42 U.S.C. § 7401, *et seq.*)

The CAA addresses air pollution at several levels. Initially, it requires the Administrator of the Environmental Protection Agency (EPA) to prescribe primary and secondary national ambient air quality standards for each air pollutant for which air quality criteria are established. (See id. § 7409(a).) Primary standards are designed to protect the public health from air pollution; secondary standards to protect the public welfare. (See id. § 7409(b).) These standards represent air quality goals applicable nationwide.

With respect to regions of the country which already have relatively clean air, the CAA imposes controls on additional air pollution. The prevention of significant deterioration (PSD) of air quality in certain units of the NPS is addressed in Part C of the CAA. (See id. §§ 7470-7491.) Of particular relevance to such units are the statutory statements of Congressional purpose in section 7470:

> (2) to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value;
>
> (3) to insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources;

and

> (5) to assure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all consequences of such a decision and after adequate procedural opportunities for informed public participation in the decisionmaking process.

To those ends Congress has prescribed maximum allowable increases over baseline concentrations--and maximum allowable concentrations--for particulate matter and sulfur dioxide air pollution in three classes of the presumably cleaner air quality control regions of the country. (See id. §§ 7407, 7473(a),(b).) While Congress did not prescribe similar limitations for other air pollutants, it did require the Administrator of EPA, after study and no later than August 7, 1979, to promulgate regulations to prevent the significant deterioration of air quality which would result from the emissions of hydrocarbons, carbon monoxide, photochemical oxidants, and nitrogen oxides. (See id. § 7476(a).) In addition, it required the Administrator to promulgate PSD regulations for other pollutants within two years after national ambient air quality standards are promulgated for those other pollutants. (Ibid.) To date the Administrator has adopted such regulations only for particulate matter and sulfur dioxide air pollution.

control of additional air pollution is to be accomplished by a permit system generally supervised by the states pursuant to EPA-approved implementation plans designed to prevent significant deterioration of air quality in those regions. (See id. §§ 7410, 7471, 7475.)

Of the foregoing "clean air" quality control regions, "class I" areas are to receive the greatest protection from additional air pollution. (See id. § 7473(b)(1).) Depending upon existing levels of air pollution, the maximum allowable increases in concentration of controlled pollutants which are permitted in class I areas can provide significantly greater protection for these regions than is provided generally under the national ambient air quality standards. Progressively greater increases of air pollution are permitted in class II and class III areas. (See id. § 7473(b)(2), (3).)

Class I areas include all of the following which were in existence on August 7, 1977: international parks, national wilderness areas and memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size. (Id. § 7472(a).) Unless redesignated as class I or class III areas pursuant to section 7474 of that title, all other NPS units--including national monuments, smaller national parks, memorial parks and wilderness areas, and all NPS units designated after August 7, 1977--are class II areas. (Id. § 7472(b).)

Further, certain NPS units may be redesignated only as class I or class II. These units include all national monuments, primitive areas, preserves, recreation areas, wild and scenic rivers, lakeshores and seashores which exceed 10,000 acres in size (id. § 7474(a)(1)) and all national parks and wilderness areas established after August 7, 1977, which exceed 10,000 acres in size (id. § 7474(a)(2)).

Baseline concentrations of each pollutant for which a ceiling has been promulgated must be established before these provisions will have any effect on additional air pollution. Baseline concentrations are set in each air quality control region at the level of concentration of each regulated air pollutant existing at the time that the first application for permission to construct a "major emitting facility" is submitted to the state containing that region. (See id. §§ 7475(a), 7479(4).)

A major emitting facility is one of a specific list of stationary sources which emits or has the potential to emit at least one hundred tons per year of any air pollutant. (See id. § 7479(1).) Sources of air pollution which are not included in that specific list are not considered major emitting facilities subject to these regulations unless they have the potential to emit at least two hundred fifty tons per year of those pollutants. (Ibid.) Further, only emissions which come from a "point source"--such as a smoke stack--are included in the two hundred fifty ton per year threshold calculation unless the EPA

Administrator promulgates a regulation specifically including in that calculation emissions that otherwise "escape" a facility, such as "fugitive emissions." (See id. § 7602(j); Alabama Power Co. v. Costle, 636 F.2d 323, 368-370 (1979).) Where no major emitting facility covered by these requirements has sought permission for construction, the PSD provisions of the CAA provide NPS units no protection against additional air pollution.

New major sources of air pollution which are subject to this permit process are required to perform detailed air quality impact analyses prior to filing a permit application, to install the best available control technology, and to conduct monitoring as necessary after operation of the facility has commenced. (Id. § 7475(a)(2)-(4), (a)(6)-(8), (e)(1)-(3).)

In addition, when a new major emitting facility may affect a federal "class I" area, the statute provides for notification of the responsible federal land manager and imposes upon him a particular duty to protect the air quality related values of the area. Section 7475(d)(2) provides:

> (A) The [EPA] Administrator shall provide notice of the permit application to the Federal Land Manager and the Federal official charged with direct responsibility for management of any lands within a class I area which may be affected by emissions from the proposed facility.
>
> (B) The Federal Land Manager and the Federal Official charged with direct responsibility for management of such lands shall have an affirmative responsibility to protect the air quality related values (including visibility) of any such lands within a class I area and to consider, in consultation with the Administrator, whether a proposed major emitting facility will have an adverse impact on such values.

In connection with NPS units the "Federal Land Manager" is the Secretary of the Interior (See id. § 7602(i)) or his delegate within the Department of the Interior (see Reorganization Plan No. 3 of 1950, 5 U.S.C. Appendix). The "Federal official charged with direct responsibility for management" of such lands presumably would be the park superintendent or comparable official.

The "affirmative responsibility" of these federal officials is delineated in some detail. If either official files a notice alleging that emissions from the proposed major emitting facility "may cause or contribute to" a change in the air quality in the class I area, a permit to construct the facility may not issue unless the owner or operator of the facility demonstrates that any resulting pollution will not exceed the maximum increases allowable under the statute. (42 U.S.C. § 7475(d)(2)(C)(i).) Further, even if the maximum allowable increases will not be exceeded by the proposed facility, a permit still may not issue if the Secretary demonstrates to the satisfaction of the state in which the facility is to be located that such facility nonetheless will have an "adverse impact on the air quality-related values (including visibility) of such" area. (Id. § 7475(d)(2)(C)(ii).)

Correspondingly, if the owner or operator of the proposed facility demonstrates to the satisfaction of the Secretary that the emissions from the facility will not have an adverse impact on such values of that area, then the state may issue a construction permit notwithstanding the fact that the emissions will cause or contribute to increases in pollutant concentrations which exceed those otherwise allowable in the area. (Id. § 7475(d)(2)(C)(iii).)

The "air quality-related values" which are to be protected from the adverse impact of a proposed major emitting facility are not defined under the Clean Air Act. They are, however, discussed in the Senate report accompanying the bill from which the adverse impact determination provision of the 1977 Amendments was taken verbatim. The Senate report states:

> [T]he term "air quality related values" of Federal lands designated as class I includes the fundamental purposes for which such lands have been established and preserved by the Congress and the responsible Federal agency. For example, under the 1916 Organic Act to establish the National Park Service (16 U.S.C. § 1), the purpose of such national park lands "is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (S. Rep. No. 95-127, 95th Cong., 1st Sess. 36 (1977).)

Similarly, in the preamble to its proposal of the regulations governing the prevention of significant deterioration of these values, EPA noted:

> According to the legislative history of the Amendments, the term "air quality related values" includes the fundamental purpose for which such lands have been established and preserved by the Congress. In addition to visibility, which is specifically cited in the Amendments, other "air quality related values" that may be considered include odor, damage to flora and fauna, geologic and cultural characteristics, acid rain and climate. (42 Fed. Reg. 57,481 (1977).)

In announcing initiation of the study required by 42 U.S.C. § 7474(d) to determine the importance of air quality related values to national monuments and preserves, the Department of the Interior defined the phrase as follows:

> Air quality related values are all those values possessed by an area except those that are not affected by changes in air quality and include all those assets of an area whose vitality, significance, or integrity is dependent in some way upon the air environment. These values include visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality. (43 Fed. Reg. 15,016 (1978).)

By imposing upon the federal land manager the affirmative responsibility of protecting air quality related values of class I areas from adverse impact by any proposed major emitting facility, and by giving him a participatory role in that protection, the CAA provides the Secretary of the Interior with specific means for the protection of some NPS units from certain additional air pollution generated by enumerated sources.

The portion of the CAA regulating new major emitting facilities has been judicially construed to apply only to those facilities which are to be constructed in "clean air" areas. (See Alabama Power Co. v. Costle, supra, 636 F.2d at 368.). It does not apply to the construction of new major emitting facilities in nonattainment (non-clean air) areas, even if they will have an adverse impact on NPS units located in nearby class I areas.

Neither do these PSD/adverse impact protections extend: 1) to class II areas, which comprise the bulk of NPS units, 2) to existing emitting facilities, or 3) to facilities smaller than those designated in the statute.

Subpart II of part C of the CAA deals with visibility protection in certain NPS units. It is both broader and narrower in scope than subpart I. It is broader because it addresses existing as well as future visibility impairment; it is narrower because its protections are afforded only to "mandatory class I areas" i.e., statutorily defined class I areas that cannot be redesignated as a less protected class. In addition, it limits the role of the Secretary of the Interior in the process of protecting visibility in NPS units to a consultative one.

In this regard, Congress has declared as a "national goal":

> the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution. (42 U.S.C. § 7491(a)(1).)

The statute directs the Administrator of EPA to promulgate regulations to carry out this national goal (see id. § 7491(a)(4)) and, after consultation with the Secretary of the Interior, to promulgate "a list of mandatory class I Federal areas in which he determines visibility is an important value." (Id. § 7491(a)(2).) The "mandatory class I Federal areas" designated here are the specific NPS units described in section 7472(a) as not being subject to redesignation to another class.

Regulations adopted by EPA pursuant to the CAA require state implementation plans to provide for notice to the Secretary of the Interior of the anticipated impacts on visibility in any Federal Class I area of any of those new major emitting facilities subject to the PSD permit process. (See 40 C.F.R. § 51.307(a)(1).) These plans also must provide for "[c]onsideration" of any analysis by the Secretary indicating that the new source will adversely affect a class I area. (See id. § 51.307(a)(3).) Unlike the PSD regulations, those pertaining to visibility protection also purport to govern new sources proposing to locate in non-attainment (non-"clean air") areas, if they will have an impact on visibility in any mandatory Class I area. (See id. § 51.307(b)(2).)

Apart from the consultative and analytical roles assigned to the Secretary of the Interior, the statute entrusts to the states the implementation of the national goal of preventing and remedying visibility impairment. Pursuant to regulations to be adopted by the EPA Administrator, state implementation plans must be designed to accomplish "reasonable progress" toward that national goal. (Id. § 7491(b)(2).) (EPA's regulations require each state plan to include a long-term (10-15 years) strategy for achieving that "reasonable progress." (40 C.F.R. § 51.306(a)(1).) In determining the reasonableness of its progress, each state is authorized to consider the cost, energy and other "nonair quality" impacts of measures which it might require for the reduction or prevention of visibility impairment. (42 U.S.C. § 7491(g)(1), (2).)

Pursuant to the statutory authority cited, the EPA Administrator has defined "visibility impairment" to mean "any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions." (40 C.F.R. § 51.301(x).) Presumably, such visibility impairment could be caused by a variety of manmade air pollutants.

Existing regulations also afford the Secretary of the Interior a role in the identification of a specific resource described in the regulations which may be affected by air pollution and which may be found worthy of protection by the states in their implementation plans. The regulations define "visibility in any mandatory Class I Federal area" to include "any integral vista associated with that area" (id. § 51.301(y)) and authorize the Secretary of the Interior to identify integral vistas for consideration by the states in their implementation plans (id. § 51.304(a)). An "integral vista" is defined to mean "a view perceived from within the mandatory Class I Federal area of a specific landmark or panorama located outside the boundary of the mandatory Class I Federal area." (Id. § 51.301(n).) (The validity of these regulations is being challenged in pending litigation.)

Under the regulations, the state is only required to consider in its cost/benefit analysis the harmful effects of air pollution upon any integral vista within its boundaries which has been identified by the Secretary according to criteria adopted by him. (Id. § 51.304(a), (d).) These criteria include, but are not limited to, "whether the integral vista is important to the visitor's visual experience" of the area. (Id. § 51.304(a).) Once an integral vista is identified properly, it is for the state to determine how much, if any, protection it should be afforded.

The Secretary's opportunity to identify integral vistas for consideration by the states in this process expires under current regulations on December 31, 1985. Absent identification by the Secretary, each state would be authorized to determine for itself which vistas, if any, are integral to any of the mandatory Class I Federal areas within its boundaries, and should be considered for protection. Pursuant to this regulatory scheme, on January 15, 1981, DOI published a proposed guideline of criteria for the identification of integral vistas and a preliminary list of specific integral vistas identified according to those criteria. (See 46 Fed. Reg. 3646.)

The opportunity afforded the Secretary to identify adverse impacts on class I areas and associated integral vistas for their possible protection by the states represents DOI's primary role in the implementation of the national goal of preventing and reducing visibility impairment in the class I Federal areas described in the statute. Whether visibility in mandatory class I areas and associated integral vistas identified by him receive any protection from air pollution will depend upon the judgments of the concerned states in weighing the benefits of protection against its costs.

There are other laws upon which the Secretary may be able to rely to some extent in any effort to protect NPS units from air pollution. Unlike the CAA, none of these authorities focusses on air quality protection. On the other hand, some of them may afford the Secretary a more substantial role in their implementation than the CAA does.

NATIONAL PARK SERVICE ORGANIC ACT

The National Park Service Organic Act (16 U.S.C. § 1, et seq.) provides that the Park Service

> shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations . . . by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. (Id. § 1.)

Section 3 of that title directs the Secretary of the Interior to "make and publish such rules and regulations as he may deem necessary or proper for the use and management" of such areas.

In 1978 Congress amended NPS legislation to reassert that the various areas of the NPS should be maintained in a manner consistent with the purpose established in title 16 U.S.C. § 1. More specifically, it declared:

> Congress further reaffirms, declares, and directs that the promotion and regulation of the various areas of the National Park System . . . shall be consistent with and founded in the purpose established by section 1 [of title 16], to the common benefit of all the people of the United States. The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress. (16 U.S.C. § 1a-1.)

The Organic Act was enacted pursuant to the Property Clause of the United States Constitution, which empowers Congress "to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States . . . ." (U.S. Const. art. IV, § 3, Cl.2.)

Two early United States Supreme Court decisions confirmed Congress' authority under the Property Clause to regulate activity occurring on non-federal property. (See *Camfield v. United States*, 167 U.S. 518 (1897) [upholding federal statute construed to prohibit fences on private land which had the effect of enclosing federal lands]; *United States v. Alford*, 274 U.S. 264 (1927) [upholding federal statute construed to prohibit the building of fires on private land near federal land without extinguishing them thereafter].)

The Court acknowledged the continued existence of that extra-territorial legislative authority of Congress more recently in *Kleppe v. New Mexico*, 426 U.S. 529 (1976). While the Court declined to define the limits of congressional power in that context, because the case before it did not demand that delineation, it nonetheless reiterated that "regulations under the Property Clause may have some effect on private lands not otherwise under federal control." (*Id.* at 546)

Several subsequent federal appellate decisions have upheld the application of federal laws and implementing regulations to non-federal lands *within* the boundaries of federal areas to further the purposes for which those federal areas are held. As the Ninth Circuit has observed:

> [The Property Clause] grants to the United States power to regulate conduct on non-federal land when reasonably necessary to protect adjacent federal property or navigable waters. (*United States v. Lindsey*, 595 F.2d 5, 6 (9th Cir. 1979).)

Pursuant to that analysis, statutes and regulations prohibiting or regulating activities within a federal conservation area regularly are applied to private inholdings.

For example, in *Free Enterprise Canoe Renters Ass'n v. Watt*, 711 F. 2d 852 (8th Cir. 1983), the Eighth Circuit upheld the application to non-federal land of a National Park Service regulation prohibiting the "'delivery or retrieval within the boundaries of Ozark National Park Scenic Riverways' of rented watercraft without a permit." (*Id.* at 856.) The court declared:

> It is undisputed that the United States acted within its constitutional authority in attempting to regulate the business activities of the members of the [plaintiff] Association as they affect the ONSR, even

> though members themselves may never enter federally owned property, but strictly keep to state or county roads and rights-of-way within the ONSR. (Id. at 855-856.)

In reaching that conclusion, the court cited its earlier construction of the Property Clause in State of Minnesota by Alexander v. Block, 660 F.2d 1240 (8th Cir. 1981), cert. denied, 455 U.S. 1007, in which it had

> concluded that "[u]nder this authority to protect public land, Congress' power must extend to regulation of conduct on or off the public land that would threaten the designated purpose of federal lands." Id. at 1249 (footnote omitted). See also United States v. Richard, 636 F.2d 236, 240 (8th Cir. 1980)(per curiam) ("federal regulation may exceed federal boundaries when necessary"), cert. denied, 450 U.S. 1033 . . . (1981) . . . . (711 F.2d at 856.)

Accordingly, the Free Enterprise court affirmed both the criminal convictions of Association members for violating the regulation by retrieving canoes from non-federal land situated within the boundaries of the federal area without a permit, and the denial of the Association's civil claim for an injunction against the enforcement of that regulation on non-federal lands. (Id. at 858.)

In State of Minnesota by Alexander v. Block, supra, 660 F.2d 1240, the court similarly had upheld the application of federal law barring the use of motorized craft within a federally designated wilderness area to lands and waters under state jurisdiction falling within the boundaries of that area. In explanation of Congress' authority to regulate activities on non-federal land, the court reasoned:

> Congress clearly has the power to dedicate federal land for particular purposes. As a necessary incident of that power, Congress must have the ability to insure that these lands be protected against interference with their intended purposes. As the Supreme Court has stated, under the property clause "[Congress] may sanction some uses and prohibit others, and may forbid interference with such as are sanctioned." McKelvey v. United States, 260 U.S. 353, 359 . . . (1922) (emphasis added). (660 F.2d at 1249.)

Applying that analysis to the federal statutes under attack in that case, the court observed:

> Thus, if Congress enacted the motorized use restrictions to protect the fundamental purpose for which the [wilderness area] had been reserved, and if the restrictions . . . reasonably relate to that end, we must conclude that Congress acted within its constitutional prerogative. (Id. at 1250.)

Concluding that the motorized use restrictions were a small part of an elaborate system of regulation considered necessary to preserve the area as a wilderness, the court held "that Congress acted within its power under the Constitution to pass needful regulations respecting public lands." (Id. at 1251, footnote omitted.)

Still earlier, the same court held that under the Property Clause Congress could prohibit hunting on waters within the boundaries of Voyageurs National Park in Minnesota, even though the waters were subject to state jurisdiction. (United States v. Brown, 552 F.2d 817, 821 (8th Cir. 1977) cert. denied, 431 U.S. 949 (1977).) In Brown, the court upheld a conviction for violating Park Service regulations against hunting in a national park. (Id. at 819.) The hunter conceded that he was hunting ducks from a boat on waters within the park, but argued that the regulation did not apply to his conduct because the waters were owned by the state. In an alternative holding the court rejected this defense. The court declared:

> Assuming arguendo that the state did not cede jurisdiction over the waters in the park, we further conclude that the federal regulations prohibiting hunting in Voyageurs Park were a constitutional exercise of congressional power under the Property Clause. (Id. at 821, footnote omitted.)

It would thus appear that by the adoption of the Organic Act, as amended, Congress has delegated to the Secretary of the Interior the general authority to impose reasonable regulations upon private inholdings in NPS units for the protection of those units and the primary purposes for which they were established and are maintained. Other specific examples of such delegation appear in 16 U.S.C. § 1902 ("all activities resulting from the exercise of valid existing mineral rights on patented or unpatented mining claims within any area of the National Park System shall be subject to such regulations prescribed by the Secretary of the Interior as he deems necessary or desirable for the preservation and management of those areas."); and 16 U.S.C. 1a-2(h) (authorizing the Secretary to "promulgate and enforce regulations concerning boating and other activities on or relating to waters located within areas of the National Park System, including waters subject to the jurisdiction of the United States . . . .")

However, most air pollution harmful to NPS units does not originate within NPS units. The issue is whether NPS Organic Act authority may be applied to air polluting activities occurring outside those units.

The court decisions do not yet recognize congressional delegations of regulatory authority to federal land managers--such as the Secretary--as including extra-territorial jurisdiction for the protection of lands within their jurisdiction. However, it has been suggested that existing laws governing regulatory jurisdiction over inholdings could support that recognition.

The general responsibilities of the Secretary of the Interior have long been recognized by the Supreme Court:

> The Secretary is the guardian of the people of the United States over the public lands. The obligations of his oath of office oblige him to see that the law is carried out, and that none of the public domain is wasted or is disposed of to a party not entitled to it. (Knight v. U.S. Land Association, 142 U.S. 161, 181 (1891).)

That prescription, considered in light of the Court's acknowledgment that Congress may "forbid interference with" the particular purposes and uses for which it has dedicated federal land (see McKelvey v. United States, 260 U.S. 353, 359 (1922), logically would appear to be as supportive of the Secretary's efforts to protect NPS units from external threats as it has been found applicable to internal threats.

Indeed, the analyses of the Eighth and Ninth Circuits discussed above in the latter context seem equally appropriate to the former. There is no obvious reason why the "power to regulate conduct on non-federal land when reasonably necessary to protect adjacent federal property" (see United States v. Lindsey, supra, 595 F.2d at 6) should extend to internally-adjacent, but not externally-adjacent non-federal lands in comparable promixity to the federal holdings. Similarly, the court's explanation of congressional authority to regulate inholdings in State of Minnesota, supra, 660 F.2d at 1249-1250, seems equally suited to external threats.

In State of Minnesota the court first noted the Supreme Court's recent reminder that "regulations under the Property Clause may have some effect on private lands not otherwise under Federal control." (Kleppe v. New Mexico, supra, 426 U.S. at 546.) It pointed out that in Kleppe the high court had relied upon Camfield v. United States, in which it had concluded many years earlier

> that Congress possessed the power to control conduct occurring off federal property through its "power of legislating for the protection of the public lands, though it may thereby involve the exercise of what is ordinarily known as the police power, so long as such power is directed solely to [the public lands'] own protection." Camfield v. United States, supra, 167 U.S. at 526 . . . . (State of Minnesota, supra, 660 F.2d at 1249.)

From this premise, the court continued:

> Under this authority to protect public land, Congress' power must extend to regulation of conduct on or off the public land that would threaten the designated purpose of federal lands. Congress clearly has the power to dedicate federal land for particular purposes. As a necessary incident of that power, Congress must have the ability to insure that these lands be protected against interference with their intended purposes . . . . Thus, if Congress enacted the . . . restrictions to protect the fundamental purpose for which the [federal area] had been reserved, and if the restrictions . . . reasonably relate to that end, we must conclude that Congress acted within its constitutional prerogative. (Id. at 1249-1250, footnote omitted.)

Despite the logical applicability of the foregoing analysis to external threats, it must be acknowledged that the courts have yet to recognize secretarial regulatory authority under existing law to protect NPS units from those threats. While the Secretary's responsibilities have been identified, his means of acquitting them have not.

The tension between the clearly perceived secretarial duty and the less clearly delineated authority to acquit it is apparent in three successive opinions of the U.S. District Court for the Northern District of California in a case brought to compel the Secretary to use his powers to protect Redwood National Park from damage allegedly caused or threatened by certain logging operations on privately owned land on the periphery of the park.

In the first of the three, in denying Interior Department motions to dismiss the action and for summary judgment, the court cited both the Organic Act and the Redwood National Park Act (16 U.S.C. §§ 79a-79j) as empowering the Secretary to protect the park from the threats perceived. (Sierra Club v. Department of Interior, 376 F. Supp. 90, 93 (N.D.Cal. 1974).) However, it was the specific mandate of the Redwood legislation upon which the court relied to discern specifically enforceable duties.

> We are of the opinion that the terms of the statute, especially § 79c(e), authorizing the Secretary "in order to afford as full protection as is reasonably possible to the timber, soil, and streams within the boundaries of the park"--"to acquire interests in land from, and to enter into contracts and cooperative agreements with, the owners of land on the periphery of the park and on the watersheds tributary to streams within the park"--impose a legal duty on the Secretary to utilize the specific powers given to him whenever reasonably necessary for the protection of the park and that any discretion vested in the Secretary concerning time, place and specifics of the exercise of such powers is subordinate to his paramount legal duty imposed . . . to protect the park. (376 F. Supp. at 96.)

In the second opinion, after trial, the court described the issue for decision as whether the Secretary had taken reasonable steps to protect the resources of Redwood National Park and, if not, whether his failure to do so was arbitrary, capricious or an abuse of discretion. (Sierra Club v. Department of Interior, 398 F. Supp. 284, 286 (N.D.Cal. 1975).) In reaching its conclusion that the Secretary had not carried out his responsibilities properly, the court noted:

> [T]he conduct of the Secretary must be considered in the light of a very unique statute--a statute which did more than establish a national park; it also expressly vested the Secretary with authority to take certain specifically stated steps designed to protect the Park from damage caused by logging operations on the surrounding privately owned lands. (398 F. Supp. at 286.)

Accordingly, while once again citing both the Organic Act and the Redwood National Park Act in support of its general conclusion, the court's order setting forth the specific "reasonable steps" that the Secretary might be obliged to take "within a reasonable time" to acquit his statutory responsibilities included only those actions identified in the "unique" Redwood park enabling legislation, to wit: acquiring interests in land and/or entering into cooperative agreements with adjoining landowners (see 16 U.S.C. § 79c(e)), and modifying park boundaries (see id. § 79b(a)). (398 F. Supp. at 294.)

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The remainder of the court's order revealingly included within possible secretarial action requests to Congress for additional funds and for clarification as to "whether the powers and duties of defendants, as herein found, are to remain or should be modified." (398 F. Supp. at 294) In short, when it came to implementing its determination that the Secretary was obliged to act to carry out his statutory duties, the court implicitly acknowledged that additional congressional action would be necessary before the Secretary would be empowered to do anything to that end not specified in the Redwood legislation.

Finally, in its third opinion, issued approximately a year later--after the Secretary reported essentially that he had apprised Congress of the state of the matter, and had neither funds nor authority to take the other actions proposed by the court in its second opinion--the court purged the Secretary of his previously found failure. (Sierra Club v. Department of Interior, 424 F. Supp. 172, 175-176 (N.D.Cal. 1976).) The court observed:

> The court further finds that, in order adequately to exercise its powers and perform its duties in a manner adequately to protect the Park, Interior now stands in need of new Congressional legislation and/or new Congressional appropriations. (Id. at 175.)

Thus, it would seem clear that the Redwood cases did not support the notion that the Organic Act endows the Secretary with extensive extra-territorial jurisdiction which would allow him to protect NPS units from threats originating on lands without them. To the contrary, the clear implication of these cases is that the Secretary's extra-territorial power is limited to that expressly identified by Congress.

At least partly in response to the Redwood cases, Congress amended the Organic Act in 1978, adopting what is now 16 U.S.C. § 1a-1. In submitting a draft bill to Congress for the purpose of expanding Redwood National Park, the Secretary of the Interior had sought express authority to regulate timbering activities on non-federal lands adjacent to the park in order to protect park resources from those activities. (See H. Rep. No. 95-581, 95th Cong., 1st Sess. 32-34 (August 5, 1977); S. Rep. No 528, 95th Cong. 1st Sess. 18-20 (Oct. 21, 1977).) Whether the Secretary's motivation in so doing was to clarify existing authorities or to create new ones is not clear. In any event, while the measure was adopted by the House of Representatives, it was rejected by the Senate on the ground that the problems to be addressed at Redwood National Park were "too urgent to place reliance on such a new concept" (i.e., legislation authorizing extra-territorial regulations). (S. Rep. No. 528, supra, 8.) Instead, Congress enacted the language now contained in section 1a-1.

In Sierra Club v. Andrus, 487 F. Supp. 443 (D.D.C. 1980), the court addressed the claim that the Secretary had failed to carry out his duties under the newly amended Organic Act, inter alia. The claim was based upon the Secretary's failure to assert and protect federal reserved water rights alleged to be threatened by various energy-related developments external to NPS units which sought to establish water rights under state law.

The court first identified the responsibilities of the Secretary by reference to the legislative history of the 1978 amendment to the Organic Act set forth in title 16 U.S.C. § 1a-1:

> "The Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the [Organic] Act to take whatever actions and seek whatever relief as will safeguard the units of the National Park System." Senate Report 95-528, 95th Cong., 1st Sess., 9 (October 21, 1977) . . . .
>
> Thus, it seems clear that in the event of a real and immediate water supply threat to the scenic, natural, historic or biotic resource values of the [NPS units there involved], the Secretary must take appropriate action. However, nowhere in either 16 U.S.C. §§ 1 or 1a-1 is there a specific direction as to how the protection of Park resources and their federal administration is to be effected . . . . The Court concludes that defendants have broad discretion in determining what actions are best calculated to protect Park resources. (487 F. Supp. at 448.)

The court then enumerated actions that the Secretary might take if the threats alleged by plaintiffs were found to be "real and immediate."

> Such actions may include, but are not limited to: 1) asserting reserved water rights, 2) acquiring water rights and rights-of-way, 16 U.S.C. § 17j-2 (1976), 3) denying the land exchange and rights-of-way which may constitute or aid a threat to Park resources, 43 U.S.C.A. §§ 1716, 1761, 1765 (West Supp. 1979), or 4) bringing trespass or nuisance actions if appropriate. (Ibid.)

However, because the court found that there was no real or immediate threat to the Park resource alleged by plaintiffs to be in jeopardy--i.e., reserved water rights--it concluded that the Secretary's failure to assert those rights had a rational basis and dismissed the actions. (Id. at 450.)

It is arguable that the court's discussion of actions that the Secretary might take to protect Park resources was dictum because of its preliminary conclusion that no threat existed which required any action on his part. Even if that discussion was not dictum, however, two things must be acknowledged: Most of the actions described--reserved water rights assertion, acquisition of rights and denial of exchanges or rights to others--were authorized specifically by independent legislative or clearly established common law sources. For the remaining possible actions--bringing trespass or nuisance actions, if appropriate--the court offered no further explanation to demonstrate their viability. While it is understandable that it would not engage in extended analysis of the possibility of such actions in view of its conclusion that no actions were required, the court's reference to reliance upon these common law remedies provides no guidance in their possible use for the protection of NPS units from external threats. (These remedies are discussed further below.)

In addition to the foregoing constitutional and statutory concerns, there is an administrative one. Traditionally, the exercise of regulatory jurisdiction pursuant to the Organic Act has been limited to activities occurring within the boundaries of NPS units. While that past practice does not automatically bar a more expansive interpretation of the Act to authorize extraterritorial regulation, it seems reasonable to suppose that the validity of such regulation would be subjected to challenge in the courts by newly affected parties. In such challenge, both the Secretary of the Interior's long standing interpretation of his regulatory power under the Organic Act as relating to activities within the boundaries of NPS units and the absence of recent judicial extension of federal regulatory power generally under the Property Clause would militate against acceptance of that broader interpretation. Under the circumstances, the utility of the administrative reinterpretation of the Organic Act to support new regulation of park-threatening activities on non-federal lands outside the boundaries of NPS units remains untested and uncertain.

It is also possible that the Organic Act may be used in conjunction with other law to provide an additional means for the protection of NPS units from external threats. That possibility arises when the language of 16 U.S.C. § 1a-1 is considered in light of the Secretary's statutory duties relating to the administration of federal lands other than NPS units.

For example, federally owned coal located without the boundaries, but in the vicinity of, NPS units may be leased in the discretion of the Secretary of the Interior. (30 U.S.C. § 201(a).) The manner in which that discretion is exercised obviously may have an effect on nearby NPS units. The question is whether the mandate of the Organic Act has any bearing on the Secretary's exercise of that discretion.

In the context of the "promotion and regulation" of NPS units consistently with the original Act's purpose, the relevant language reads:

> The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress. (16 U.S.C. § 1a-1.)

The legislative history of section 1a-1 does not clarify the limits of its application. On the one hand, it could be argued from the context of the statute that the policy set forth therein relates solely to the regulation of activities occurring within NPS units as those activities may bear upon the purposes for which such lands have been dedicated. If so, the statute provides no additional guidance for dealing with external threats.

On the other hand, because of its inherent ambiguity, the statute could be construed to relate to the total range of programmatic discretion vested in the Secretary under a variety of laws, including the coal leasing statutes. How the Secretary exercises that discretion could have relevance to the "promotion" of NPS units. If that interpretation were substantiated, the statutory policy could be useful in the Secretary's attempt to protect NPS units from external threats originating on other lands under his jurisdiction.

However, the latter interpretation would itself generate further interpretive problems. The last clause of the excerpt quoted from section 1a-1 excepts from the generally protective thrust of the statute those activities which "may have been or shall be directly and specifically provided by Congress." The question is: To which statutorily authorized activities does this exception apply?

It can be argued that all laws authorizing the Secretary to undertake or oversee developmental activities--such as the coal leasing or surface mine permitting statutes--are "directly and specifically provided by Congress," and so excepted from the policy defined in section 1a-1. Another reading of the exception would limit it to those secretarial duties mandated by Congress. The narrowest interpretation of the exception would require statutory acknowledgement of the possible adverse consequences of authorized or mandated activities to NPS units before it became applicable. In these last cases there could be little question that Congress meant the exception to apply.

Neither section 1a-1 nor its legislative history speaks directly to the issue, however, and it would appear that resolution of conflicts between the directive of section 1a-1 and other statutory authorities must be undertaken on an ad hoc basis pending judicial clarification. For all of the foregoing reasons, the Organic Act, whether utilized independently or in conjunction with other laws, currently is neither a certain nor an expeditious tool for the protection of NPS units from the harmful effects of air pollution originating outside those units.

Other statutory programs administered by the Secretary have specific reference to the protection of NPS units. The Surface Mining Control and Reclamation Act is one.

SURFACE MINING CONTROL AND RECLAMATION ACT

The primary protections for NPS units under this Act (30 U.S.C. § 1201, et seq.) can be found in section 1272. Insofar as relevant to our inquiry, section 1272(e) provides that after August 3, 1977, and subject to "valid existing rights", no surface coal mining operations which did not exist on that date shall be permitted:

> (1) on any lands within the boundaries of units of the National Park System, the National Wildlife Refuge System, the National System of Trails, the National Wilderness Preservation System, the Wild and Scenic Rivers System, including study rivers designated under section 1276(a) of title 16 and National Recreation Areas designated by Act of Congress;
>
> . . .
>
> (3) which will adversely affect any publicly owned park or places included in the National Register of Historic Sites unless approved jointly by the regulatory authority and the Federal, State, or local agency with jurisdiction over the park or the historic site;
>
> . . .
>
> (5) . . . within three hundred feet of any . . . public park . . . .

It should be emphasized that these prohibitions against new surface coal mining within the NPS units identified (including private inholdings within the boundaries of these units), and within a three-hundred foot buffer zone surrounding any "public park," and on other land when it will "adversely affect" the public lands indicated, are subject to an important exception:

Each of the three mining prohibitions set forth is subject to "valid existing rights." Until recently, those rights generally were defined as follows:

> A person possesses valid existing rights for an area protected under section [1272(e)] on August 3, 1977, if the application of any of the prohibitions contained in that section to the property interest that existed on that date would effect a taking of the person's property which would entitle the person to just compensation under the Fifth and Fourteenth Amendments to the United States Constitution; (30 C.F.R. § 761.5(a).)

In addition,

> A person possesses valid existing rights if the person proposing to conduct surface coal mining operations can demonstrate that the coal is both needed for, and immediately adjacent to, an ongoing surface coal mining operation which existed on August 3, 1977. A determination that coal is "needed for" will be based upon a finding that the extension of mining is essential to make the surface coal mining operation as a whole economically viable; (Id. § 761.5(c).)

However, in a recent round of litigation challenging the Secretary's regulations under this Act, both regulatory definitions were remanded for his reconsideration upon a finding by the district court that he had failed to comply with the notice and comment requirements of the Administrative Procedures Act. (In Re: Permanent Surface Mining Regulation Litigation, No. 79-1144 (D.D.C. March 22, 1985) (Mem. Op. at pp. 4-11, 18-20).) Pending promulgation of acceptable regulations defining "valid existing rights," it is virtually impossible to provide any reasonably accurate analysis of the degree of protection provided NPS units by the foregoing prohibitions against certain surface coal mining.

Apart from such "valid existing rights," the prohibitions against mining within the federal areas identified and within 300 feet of public parks are fairly straightforward. Less clear is the regulation of surface coal mining in areas outside these units which will "adversely affect any publicly owned park." (30 U.S.C. § 1272(e)(3).) The Act sets forth no specific indication as to when surface coal mines may be found to threaten such adverse effect.

For example, one relevant provision directs coal operators "to effectively control erosion and attendant air and water pollution . . . ." (Id. § 1265(b)(4).) However, an attempt by the

Secretary to protect air quality by regulating all fugitive dust emissions from surface coal mines under this provision was struck down by the court as an overbroad interpretation of the statute. (*In Re: Permanent Surface Mining Regulation Litigation*, No. 79-1144 (D.D.C. May 16, 1980) (Mem. Op. at pp. 27-29).) The court ruled that only air pollution related to erosion could be regulated under this statute, notwithstanding the Secretary's apparent assertion that in this context "most sources of air pollution stem from surface mining operations unrelated to erosion activities." (*Id.* at p. 28.) The court observed: "Moreover, if Congress wanted the Secretary to develop regulations protecting air quality, it could have done so in a straightforward manner." (*Id.* at p. 29.) In a subsequent opinion, the court reaffirmed its ruling, relying on the Act itself (see 30 U.S.C. § 1292(a)) to conclude that "EPA has the authority to regulate fugitive dust from surface mines under the Clean Air Act . . . ." (July 6, 1984 mem. opn. at p. 34.)

In the only reported case of which we are aware that raised the issue of park protection in the context of section 1272, former Secretary of the Interior Andrus concluded that surface coal mine fugitive dust at levels expected to result from a mining operation in the Alton Coal Fields in close proximity to Bryce Canyon National Park would *not* adversely affect the park. He did not, however, exclude consideration of such dust in ascertaining adverse effects. In addition, he concluded that other aspects of the mining operation (including noise and unsightliness) *would* adversely affect the park and, accordingly, determined that such land was "unsuitable" for mining. That decision was upheld by the United States District Court in *Utah Intern. v. Dept. of Interior of the U.S.*, 553 F. Supp. 872 (C.D. Utah 1982).

In addition to the three specific prohibitions set forth in section 1272(e), *supra*, the Act authorizes any person "having an interest which is or may be adversely affected" by surface coal mining to petition the Secretary of the Interior to have an area designated as unsuitable for mining. (30 U.S.C. § 1272(c).) Similarly, the Secretary is himself directed to determine whether there are federal lands which are unsuitable for surface coal mining. (*Id.* § 1272(b).) Insofar as relevant here, a determination of unsuitability would require a finding that the mining operations will "affect fragile or historic lands in which such operations could result in significant damage to important historic, cultural, scientific, and esthetic values and natural systems." (*Id.* § 1272(a)(3)(B).) The Alton decision upheld in *Utah Intern., supra*, was precipitated by a petition filed pursuant to section 1272(c) by several individuals and groups interested in environmental protection.

Although "valid existing rights" are not expressly exempted from the statutory unsuitability petition process, a recent ruling of the Interior Board of Surface Mining Appeals has incorporated that exemption into the process. In that ruling the Board concluded that land which is open to surface coal mining as a result of valid existing rights cannot be designated unsuitable for mining pursuant to a petition filed under section 1272(c). (See In Re: Shavers Fork Watershed Unsuitability Petition, IBSMA 81-64, 4 IBSMA 192, 197 (Dec. 10, 1982).)

It is apparent that the current applicability of the "valid existing rights" exemption to both the specific prohibitions against surface coal mining set forth in section 1272(e) and the unsuitability petition process of section 1272(c) contributes to the substantial uncertainty concerning the amount of protection from air pollution available to NPS units under the Surface Mining Control and Reclamation Act, as that Act was construed by the May 16, 1980, and July 6, 1984, opinions in In Re: Permanent Surface Mining Regulation Litigation, supra.

COMMON LAW ACTIONS

It has been suggested that protection of NPS units from external threats--such as air pollution--could be accomplished through traditional common law actions like those for nuisance or trespass, where appropriate. (See Sierra Club v. Andrus, supra, 487 F. Supp. at 488.) (Because the same principles apply to the availability of both remedies, we will limit our discussion to the former.) Initially, it must be noted that such remedies are cumbersome and by their nature can be invoked only after the damage is done or appears inevitable.

More importantly, there currently is substantial doubt as to the availability of these remedies in this context because Congress has addressed air quality protection in NPS units--as elsewhere --comprehensively in the Clean Air Act (CAA) and the regulatory scheme mandated therein. This legislative initiative impinges upon both federal common law and state common law governing these remedies.

In the early 1900's the United States Supreme Court utilized federal common law to resolve interstate air and water pollution problems, without labeling it as such. (See Georgia v. Tennessee Copper Co., 206 U.S. 230 (1907); Missouri v. Illinois, 200 U.S. 496 (1906).) In 1971 the Tenth Circuit invoked the federal common law by name to address a claim by the State of Texas that pesticide runoff from the State of New Mexico was polluting its waters, declaring: "Federal common law and not the varying common law of the individual States is . . . a basis for dealing in uniform standard with the environmental rights of a State against improper impairment by sources outside its domain." (Texas v. Pankey, 441 F.2d 236, 241 (10th Cir., 1971).)

Subsequently, the Supreme Court adopted the same approach in another interstate water pollution dispute. "When we deal with air or water in their ambient or interstate aspects, there is a federal common law." (Illinois v. City of Milwaukee (Milwaukee I) 406 U.S. 91, 103 (1972), footnote omitted.) It explained that the courts had fashioned a federal common law "where there is an overriding federal interest in the need for a uniform rule of decision or where the controversy touches basic interests of federalism . . . . " (Id. at 105, n. 6.)

Shortly after Milwaukee I was decided, Congress passed the 1972 Amendments to the Federal Water Pollution Control Act (FWPCA), which created a permit system for the discharge of pollutants into interstate waters. (See 33 U.S.C. §§ 1251-1376.) In a subsequent stage of the water pollution dispute between Illinois and Milwaukee, the Supreme Court ruled that the federal common law of nuisance had been supplanted in the water pollution field by the adoption of the FWPCA. (Milwaukee v. Illinois (Milwaukee II), 451 U.S. 304, 317 (1981).) The court declared:

> Federal common law is a "necessary expedient," . . . and when Congress addresses a question previously governed by a decision rested on federal common law the need for such an unusual exercise of lawmaking by federal courts disappears. (Id. at 314, citation omitted.)

The Court noted that the Pankey case, upon which it relied extensively in Milwaukee I, had itself observed that "federal common law applies '[u]ntil the field has been made the subject of comprehensive legislation or authorized administrative standards . . . . '" (Ibid., quoting Texas v. Pankey, supra, 441 F.2d at 241.) The appropriate question, the Milwaukee II court said, was "whether the legislative scheme 'spoke directly to a question' . . . not whether Congress had affirmatively proscribed the use of federal common law." (451 U.S. at 315.)

The Court concluded that in context of the problem before it,

> Congress has not left the formulation of appropriate federal standards to the courts through application of often vague and indeterminate nuisance concepts and maxims of equity jurisprudence, but rather has occupied the field through the establishment of a comprehensive regulatory program supervised by an expert administrative agency. (Id. at 317.)

Further, with respect to the content of the legislative approach to the problem perceived, the Court declared:

> Although a federal court may disagree with the regulatory approach taken by the agency with responsibility for issuing permits under the Act, such disagreement alone is no basis for the creation of federal common law. . . .

> The question is whether the field has been occupied, not whether it has been occupied in a particular manner. (Id. at 323, 324.)

Two months later, in a case rejecting the common law claims of fishermen against various governmental entities for damage to fishing grounds caused by discharges and ocean dumpage of sewage and other waste, the Court laid to rest any doubt in the matter.

> The Court has now held that the federal common law of nuisance in the area of water pollution is entirely preempted by the more comprehensive scope of the FWPCA . . . . (Middlesex Cty. Sewerage Auth. v. Sea Clammers, 452 U.S. 1, 21-22 (1981).)

While the Supreme Court has yet to address the issue of preemption of any federal common law of nuisance in the area of air pollution, the foregoing analysis of the closely analogous problem in the water pollution area would seem controlling. The CAA, like the FWPCA, establishes a comprehensive regulatory program supervised by the same expert administrative agency--EPA. Whatever objections may be posed to the manner in which Congress has elected to regulate air pollution under that program, it can hardly be denied that Congress has addressed the question directly.

On this reasoning, at least one federal court has dismissed a nuisance action for damages brought by the United States against a landfill operator, declaring:

> Since Congress has addressed the problem of air pollution in the Clean Air Act, I find that the statute pre-empts plaintiff's federal common-law claim for nuisance. (United States v. Kin-Buc, Inc., 532 F. Supp. 699, 702 (D.N.J. 1982).

Similarly, in successive opinions, the Second Circuit affirmed dismissal of federal common law nuisance claims brought against EPA (New England Legal Foundation v. Costle, 632 F.2d 936 (2 Cir. 1980)) and a lighting company (New England Legal Foundation v. Costle, 666 F.2d 30 (2 Cir. 1981)) for the latter's use of a high sulfur fuel after EPA approval. While the court did not reach the "broad question of whether the Clean Air Act totally preempts federal common law nuisance actions based on the emission of chemical pollutants into the air" (id. at 32), its analysis followed the rationale underlying preemption determinations:

> Our affirmance is specifically on the ground that the EPA's approval of [the lighting company's] use of high sulphur fuel precludes

> appellants from maintaining a common law nuisance action against [the company]. (Ibid.)

It has been suggested that the CAA's "saving" clauses may preserve federal common law remedies. However, there would seem to be little basis for so concluding.

In the section of the CAA authorizing "citizen suits," there is the following provision:

> Nothing in this section shall restrict any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any emission standard or limitation or to seek any other relief . . . . (42 U.S.C. § 7604(e).)

In Milwaukee II, however, the Supreme Court rejected the claim that practically identical language--substituting the word "effluent" for "emission"--contained in the citizen-suit section of the FWPCA (33 U.S.C. § 1365(e)) had the saving effect also argued for in that case. The Court noted:

> The subsection is common language accompanying citizen-suit provisions and we think it means only that the provision of such suit does not revoke other remedies. It most assuredly cannot be read to mean that the Act as a whole does not supplant formerly available federal common-law actions . . . . (451 U.S. at 329; accord Kin-Buc, Inc., supra, 532 F. Supp. at 703.)

It is suggestive of a "substantive" approach to preemption analysis that the Court found federal common law preempted by the FWPCA notwithstanding fairly specific evidence to the contrary in the relevant legislative history. As the Milwaukee II dissent argued:

> [T]he Court ignores express statements of legislative intent that contradict its position. The Senate Report accompanying the 1972 legislation explicitly describes the congressional intent informing [33 U.S.C. § 1365(e)]:
>
> > "It should be noted, however, that the section would specifically preserve any rights or remedies under any other law. Thus, if damages could be shown, other remedies would remain available. Compliance with requirements under

> > this Act would not be a defense to a common law action for pollution damages." S. Rep. NO 92-414, p. 81 (1971), reprinted in 2 Legislative History of the Water Pollution Control Act Amendments of 1972 (Committee Print compiled for the Senate Committee on Public Works by the Library of Congress). Ser. No. 93-1, p. 1499 (1973) (Leg. Hist.)
>
> This deliberate preservation of all remedies previously available at common law makes no distinction between the common law of individual States and federal common law. (451 U.S. at 343, Blackmun, J., dissenting, footnote omitted.)

Apparently, the Milwaukee II majority was guided by the appropriateness of the statutory solution--because of the latter's comprehensive approach to a complex problem requiring oversight by an expert administrative agency--in finding federal common law had been preempted in the area of water pollution control by the FWPCA, nothwithstanding evidence of contrary congressional intent. A similar approach would seem likely with respect to air pollution and the CAA.

The CAA also contains the following provision:

> [T]his chapter [title 42 U.S.C. §§ 7401-7642] shall not be construed as superseding or limiting the authorities and responsibilities, under any other provision of law, of the [EPA] Administrator or any other Federal official, department or agency. (42 U.S.C. § 7610(a).)

It may be argued that this provision could be read to preserve the Secretary's option to utilize common law remedies--such as nuisance actions--to address sources of air pollution outside NPS units which threaten those units. By comparison, the FWPCA's similar "saving" clause is more qualified, preserving only "the authority or functions of any officer or agency of the United States not inconsistent with this chapter . . . ." (33 U.S.C. § 1371(a).)

Neither Milwaukee II nor Seaclammers discussed the effect of section 1371(a) on their respective conclusions that the FWPCA preempted federal common law in the area of water pollution. Those preemption determinations, however, at least implicitly reject any "saving" effect of that section. Nonetheless, because of the more comprehensive "saving" language of the CAA provision embodied in 42 U.S.C. § 7610(a), it can be argued that the

Court's implicit determination that 33 U.S.C. § 1371(a) does not preserve federal common law actions has less bearing on any similar argument which might be made under the CAA.

However, it seems unlikely that the Supreme Court would conclude Congress preserved the viability of judicially created federal common law rights of action, such as those for nuisance, in this general formulation. If the Court was willing to find preemption of federal common law by the FWPCA notwithstanding the specific contrary legislative history noted by the dissent in Milwaukee II (and discussed above), it would seem unlikely to be swayed by the argument that the CAA sought to preserve federal common law by the general language of section 7610(a). (It would seem reasonable to suppose that the contrary view of a federal district court which had relied upon the court of appeal decision vacated in Milwaukee II (see United States v. Atlantic-Richfield Co., 478 F. Supp. 1215, 1219 (D. Mont. 1979)) has lost its foundation. (See Kin-Buc, Inc. supra, 532 F. Supp. at 702.))

Considering the tenor of the Court's preemption analysis under the FWPCA and the similarly comprehensive approach to air pollution under the CAA, little reliance can be placed upon sections 7604(e) and 7610(a) as preservers of a federal common law of nuisance in this context.

There are other differences between the CAA and the FWPCA, of course, and only judicial interpretation can determine whether the former, like the latter, has "occupied the field" to the exclusion of federal common law. It is our opinion, however, that the Secretary cannot rely with confidence upon any federal common law of nuisance in any effort to protect NPS units from the adverse effects of air pollution generated outside the boundaries of those units.

By implication Milwaukee II raises--but does not analyze or resolve--the possibility of the existence of another body of law which may support nuisance actions for relief from air pollution: the common law of the States. For comparison in discussing preemption of federal common law by federal statutes the Court observed:

> Contrary to the suggestions of respondents, the appropriate analysis in determining if federal statutory law governs a question previously the subject of federal common law is not the same as that employed in deciding if federal law pre-empts state law. In considering the latter question "'we start with the assumption that the historic public powers of the States were not to be superseded by the Federal Act unless that was the clear and manifest purpose of Congress.'" Jones v. Rath Packing Co., 430 U.S. 519, 525 (1977) (quoting Rice v. Santa Fe Elevator

> Corp., 331 U.S. 218, 230 (1947)). While we have not hesitated to find pre-emption of state law, whether express or implied, when Congress has so indicated, see Ray v. Atantic Richfield Co., 435 U.S. 151, 157 (1978), or when enforcement of state regulations would impair "federal superintendence of the field," Florida Lime & Avocado Growers, Inc. v. Paul, 373 U.S. 132, 142 (1963), our analysis has included "due regard for the presuppositions of our embracing federal system, including the principle of diffusion of power not as a matter of doctrinaire localism but as a promoter of democracy." San Diego Building Trades Council v. Garmon, 359 U.S. 236, 243 (1959). Such concerns are not implicated in the same fashion when the question is whether federal statutory or federal common law governs, and accordingly the same sort of evidence of a clear and manifest purpose is not required. Indeed, as noted, in cases such as the present "we start with the assumption" that it is for Congress not federal courts, to articulate the appropriate standards to be applied as a matter of federal law. (Milwaukee II, supra, 451 U.S. at 316-317, footnote omitted.)

The Court's general comparison did not expressly address the possibility that state common law may survive its conclusion of preemption of federal common law by the federal legislation. The dissent, however, did:

> By eliminating the federal common law of nuisance in this area, the Court in effect is encouraging recourse to state law whenever the federal statutory scheme is perceived to offer inadequate protection against pollution from outside the State, either in its enforcement standards or in the remedies afforded. This recourse is now inevitable under a statutory scheme that accords a significant role to state as well as federal law. But in the present context it is also unfortunate, since it undermines the Court's prior conclusion that it is federal rather than state law that should govern the regulation of interstate water pollution. Illinois v. Milwaukee, 406 U.S., at 102. Instead of promoting a more uniform federal approach to the problem of alleviating interstate pollution, I fear that today's decision will lead States to turn to their own courts for statutory or common-law

> assistance in filling the interstices of the federal statute. (451 U.S. at 353-354, Blackmun, J. dissenting.)

It is unclear whether the dissent's characterization of the availability of state common law would be accepted by the Court if the issue were presented for decision. As indicated, the majority discussed it only to describe the relative ease of finding preemption of federal common law.

However, it is suggested that the very progression of pollution problem-solving discussed above--from state common law to federal common law to federal legislation--precludes reliance at this stage on the common law of the states relating to nuisance actions. Apparently, the impetus for the development of federal common law in this area was the inadequacy of differing concepts of state common law doctrines to deal with ambient pollutants. (See Texas v. Pankey, supra, 441 F.2d at 241.) As Milwaukee I suggested: "When we deal with air or water in their ambient or interstate aspects, there is a federal common law" because of the "overriding federal interest in the need for a uniform rule of decision . . . ." (Milwaukee I, supra, 406 U.S. at 103, 105, n. 6; see Hinderlider v. La Plata Co., 304 U.S. 92, 110 (1938).) In short, where federal concerns mandate the application of federal common law, state common law is superseded.

That analysis has lost none of its force by the Court's subsequent conclusion that federal legislation removed the need for federal common law. Rather, the congressional initiative presumably addressed the same problem of disparate state common law doctrines, but in a more uniform and comprehensive manner. Under the circumstances, it would appear that an attempt to revert to the earlier reliance upon state common law is unlikely to succeed.

Accordingly, on the basis of existing court decisions, substantial doubt exists as to the availability of federal or state common law actions for nuisance (or trespass) as means to protect NPS units from the adverse effects of air pollution generated outside those units.

CONCLUSION

Various laws may be utilized by the Department of the Interior to some extent to protect NPS units from the harmful effects of air pollution. None provides complete protection.

Some authorities seem better suited for the task than others. Other authorities may have been preempted by the Clean Air Act. That Act addresses the problem of air pollution in NPS units and elsewhere comprehensively, and affords the Secretary opportunities to participate in that protection.

To a certain extent the effectiveness of existing law to deal with this problem will be determined case by case in the litigation process. Statutory mandates will have to be interpreted by the Secretary in the context of specific problems. Ultimately, those judgments will be tested and resolved in the courts, where the Justice Department is responsible for defending the interests of the United States. How those actions are prosecuted and defended will play a role in the development of the law for the protection of NPS units from the harmful effects of air pollution.

Keith E. Eastin

OUTLINE

"VEGETATION RESPONSE TO AIR POLLUTANTS"

O. Clifton Taylor

Statewide Air Pollution Research Center
University of California
Riverside, California 92521

Presentation at Congressional Hearing

May 21, 1985

Dr. O. Clifton Taylor
Professor of Plant Sciences

Statewide Air Pollution Research Center
and Botany and Plant Science Department
University of California, Riverside, California

- Air pollutant effects assessment research in California.
- Identification of phytotoxicants in "smog"

  1. Ozone
  2. Peroxyacetyl nitrate

- Identification of injury symptoms and relative susceptibility of species, varieties and cultivars
- Assessment of economic crop loss
  - Agricultural Air Research Project (1962)
    - Funded largely by local government and industries
    - Results
      - Lemon and navel orange yield reduced about 35% by ozone in ambient "smog"
      - Grape yield reduced about 50% by ozone in ambient "smog"
  - Impact of oxidants on a coniferous forest ecosystem (San Bernardino National Forest, 1973-1978)
    - Funded by EPA
    - Results

      Order of susceptibility - Ponderosa pine, Jeffrey pine, White fir, Black Oak, Incense Cedar, Sugar pine

      - Increased pine beetle damage
      - Increased root rot (Phomes Annosus)
      - Increased fire hazard
      - Decreased lateral trunk growth
      - Decreased survival of pine seedlings

    - Change in forest species composition
    - Increased defoliation

- National Crop Loss Assessment Network (1982-present)
  - Funding - EPA - Western Oil and Gas Association and Cotton Producers Seed Distributors
  - Cooperative National Project
    - University of California, Riverside
    - Argonne National Laboratory
    - Lawrence Livermore National Laboratory
    - USDA-AR Laboratory-North Carolina State University
    - Boyce Thompson Institute
    - USDA-Beltsville
    - Oregon State University
    - EPA-ERL, Corvallis, Oregon
  - Research Objectives
    - Measure dose-response of 10 leading crops of the U.S.
    - Measure interaction between SO_2 and O_3
    - Develop or adapt models to utilize crop response data to assess national loss
  - California Participation
    - Research facility at USDA Cotton Research Station, Shafter
    - Crops used in study
      - Cotton (SJ2) - 2 seasons
      - Winter barley - 2 seasons
      - Head lettuce (Empire) - 1 season
      - Alfalfa (WL514) - now in 2nd season

- **Treatments**
  - **Ozone - six different concentrations**
  - **Two soil moisture levels**
  - **Two replications (total of 24 field fumigation chambers)**
- **Results**
  - Cotton - 15 to 20% reduced yield from ambient ozone
  - Barley - no ambient effect; addition of O_3 - yield loss
  - Lettuce - no ambient effect; O_3 additions delayed maturity and reduced head size
  - Alfalfa - no effect of ambient; yield reduction with additional O_3
- Parlier Field Station
  - Cotton (SJ2, SJ5 and SC-1)
  - Sugar beets
  - Alfalfa (Moapa and WL512)
  - Thompson seedless grape
- Results
  - Ambient O_3
    - SJ2 - 15-17% yield reduction
    - SJ5 and SC-1 no effect
    - Sugar beet no effect
    - Thompson seedless grape - 18 to 28% loss
    - Alfalfa
      - Moapa - 3 season ave 16% loss
      - WL512 - 5% reduction not statistically significant
  - O_3 additions
    - Addition of O_3 to ambient increased crop loss in all species

- Native species in Sierra Mountains
  - Field surveys in 1971 and 1977 showed visible ozone injury symptoms on major tree species in Sierras including Yosemite National Park
  - Effects of ozone and sulfur dioxide mixtures on forest vegetation of the southern Sierras.
    - O_3 injury on Jeffrey pines
    - No injury from SO_2
    - Accumulation of S near base of mountains (Greenhorn & Breckenridge) and at 5,000 to 7,000 ft. level.
    - Fumigation with $SO_2 + O_3$ mix.

      Ponderosa & Jeffrey Pines and Giant Sequoia seedlings - visible injury symptoms more than additive.

TESTIMONY OF

GEORGE GREEN

WESTERN ENERGY SUPPLY & TRANSMISSION (WEST) ASSOCIATES

BEFORE THE
U.S. HOUSE OF REPRESENTATIVES
INTERIOR AND INSULAR AFFAIRS COMMITTEE
SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION

CONCERNING

AIR QUALITY IN THE NATIONAL PARKS IN THE WEST

MAY 20 & 21, 1985

Western Energy Supply and Transmission (WEST) Associates is a planning and research organization comprised of twenty-one members from various sectors of the electric utility industry, including investor-owned utilities, publicly-owned utilities, and rural electric cooperatives. The organization was founded in 1964 and one of its primary objectives is to conduct research and investigate methods of generating power while maintaining minimum possible impact on the environment. The members of WEST provide electric utility service to nineteen million customers in eight western states.

WEST Associates, and its member utilities, are currently sponsoring environmental research activities that include:

- Development of a visibility prediction model;
- Investigation of the human perception of visibility;
- Investigation of rain chemistry near a western power plant;
- Determination of the relationship between monitored rain chemistry and soil chemistry;
- Measurement of the chemistry of nitrogen oxidation in power plant plumes; and
- Determination of the acidification status of Colorado lakes.

Additional environmental studies which have recently been completed by WEST Associates include:

- Determination of what constitutes significant and adverse visibility impairment;
- Investigation of the relative light scattering visibility effects of natural and manmade particles;
- Measurement of the effects of lightning activity on precipitation chemistry;

- Study of air pollution resource damage in the West;
- Determination of the proper interpretation of telephotometer data;
- Evaluation of the various natural causes of telephotometer target coloration;
- Measurement of sulfate formation in power plant plumes; and
- A literature review of visibility research.

These, and other studies, have been conducted by WEST Associates over the last decade at an expense of several hundred thousand dollars. However, this research is only a fraction of the total body of research being conducted on western air quality. We believe that appropriately conducted research is the key that will unlock the proper understanding of air quality in the West.

Until credible research is completed, the discussion of the issue of western air quality tends to be dominated by sensational statements which are subsequently disproven by facts elicited by further research. We offer several examples of misconceptions which cause 'fiction going before fact' analysis of western air quality.

1) On August 4, 1977, the Honorable Henry A. Waxman, Representative from the the State of California, read the following statement into the Congressional Record:

> "The Navajo Power Plant can expect to retrofit with additional pollution controls to limit the vast deterioration in visibility which their plume has caused. It is our intent that aggressive steps be taken to reduce this eyesore which has defaced our Grand Vistas in the West..."

The presumption was strongly set in the minds of members of Congress and their staff that sulfur dioxide emissions from single point sources, such as Navajo, were primarily responsible for the haze observed in the Southwest, and that by reducing such emissions significantly, all visibility problems would be solved. Ironically, studies conducted later by the Environmental Protection Agency (EPA) and industry showed conclusively, through trajectory analysis and chemical analysis of the particulate matter present during haze episodes over the Grand Canyon, that a significant contributor to haze in the Grand Canyon area was the urban plume from southern California, including Congressman Waxman's district, and other distant sources. During another haze episode, the source was found to be a forest fire some 180 miles distant. Such smoke could sometimes be due to forest management practices of the Forest and Park Services.

2) On May 12, 1977, the Committee on Interstate and Foreign Commerce concluded that, "It would be impracticable to require a major city, such as Los Angeles, to meet the same visibility standards as the Grand Canyon." They did not recognize at the time the tremendous impact such a megalopolis has on the visibility 500 miles away.

3) In March of 1977, the National Paks and Conservation Association testified before the Congressional Health and Environmental Subcommittee that "There is evidence that some areas that in the past had 100 mile visibility now have only an average of 30 mile visibility. Much of this can probably be attributed to emissions from power plants such as the Navajo." Visibility measurements made in the vicinity of Navajo by both industry and the EPA, and reported at a national symposium on "Plumes and Visibility: Measurement and Model Components" held at Grand Canyon National Park, Arizona on November 10-14, 1980, and other studies reported in the literature, do not support this perception. There was even sufficient evidence available at the time of the charge to refute it, but nothing was done.

4) Many people have the misconception that natural sources are insignificant contributors to visibility impairment. For example, windblown dust is not thought to contribute significantly. It has been found that windblown dust from agricultural areas, and elsewhere, can be extremely fine and thus remain suspended for great distances. Additionally, significant amounts of pollen, terpenes and carbonaceous material (from both wild fires and controlled burns) are present and can affect visibility. Carbonaceous material from controlled burns in Forest and Park Service areas may be especially noticeable since they often originiate in or near the pristine areas.

5) Another faulted conception is that physical measurements could adequately portray human perception of visibility impairment. Several instruments, including the teleradiometer developed by the Park Service, provide only an indirect indication of visibility. The instruments are often touted as providing complete answers, when in reality they provide only indices or partial answers. One of the chief drawbacks of the teleradiometer type of instrument is the subjectivity of its human operator in the interpretation of results, including adjustments for weather, cloud shadows, and the inherent contrast of the target. The cummulative uncertainty of data obtained with any instruments must be fully substantiated before scientific meaning can be placed on the derived results. This has not been done. The Park Service also uses cameras to document and derive visibility indices. While photos could tell us much more about the visibility than teleradiometer type observations, the Park Service uses 135 mm telephoto lenses in their work, which do not represent what the human eye sees. Further, in analyzing the results, one encounters many of the same interpretative problems as with teleradiometer type observations.

6) Another example of fiction going before fact came from an incident that occurred the summer of 1984 at a conference held at Western State College in Gunnison, Colorado. Two scientists attending the conference on acid rain, one from New England and one from West

Germany, both alleged experts in forest damage, took a casual stroll in the woods near Gothic, Colorado. These two scientists observed what they thought was tree damage due to acid rain. The news media treated this 'discovery' as the first definitive evidence of acid rain damage in the West. Indeed, the Denver Post ran an article in their July 25, 1984 issue with a headline which read, "First Acid Rain Damaged Trees Found in State".

The federal Environmental Protection Agency followed up on this 'discovery' by retaining a committee of experts, headed by Dr. Robert Bruck of North Carolina State University. All of the members of the team, including Dr. Bruck, are experts in air pollution forest damage and have viewed, firsthand, actual acid rain damage to forests in the eastern United States and in Europe.

The Bruck team traveled to the Gothic area later in the summer of 1984 and did a very extensive study of the condition of the forest. While the team did find that damage to the forest had occurred in the area, they attributed it to natural causes, including fungus attack which normally occurs in any natural forest. The report they wrote, entitled "Investigation Into the Health of Forests in the Vicinity of Gothic, Colorado" specifically stated:

> "THE MAJOR CONCLUSION IS THAT THERE IS NOW NO EVIDENCE TO INDICATE THAT AIR POLLUTION IS CONTRIBUTING TO NATURAL FOREST PROCESSES IN THE GOTHIC AREA" (emphasis in original).
>
> "Still, this experience contains some important lessons. First, where public and media interest is intense, scientists should use extra care in offering conclusions to extremely complex questions. Second, we need comprehensive baseline research and monitoring to assess the link between atmospheric deposition and forest health in the western United States."

The report concluded:

> "If aither of these principles is neglected, the scientific community, public decision makers, and the public at large may be misled when making important policy decisions about changes to ecosystems."

The Bruck Study team also examined forests at higher elevations in Colorado. They did this because, by experience in Europe and the eastern United States, they expected more acid rain damage at the higher elevations. Instead, the team found a very vigorous and healthy natural forest. Their conclusion is that there is no documented forest damage due to acid rain in Colorado.

7) The last example of uncertainty coming before fact is the recently released World Resources Institute study entitled "The American West's Acid Rain Test". The report itself is a reasonably well written survey of the literature in the field of acid rain. The report does suffer from the fact that a great deal of the cited studies concern areas of the world other than the western United States, such as Scandanavia and western Europe. The report contains no new research of data; it consists of only a compilation of observations and then extrapolations of what 'might' or 'could' 'potentially' occur. It does not indicate that there is a current acid rain impact in the West. Rather, the report does indicate that certain precursors do exist which could lead to reasonble further study. WRI merely suggests that further research be done.

The press release prepared by WRI, however, portrays the study as "the first comprehensive study of acid rain in the American West". The press release states:

> "We no longer have only suspicion; for the first time we have a reasonably complete picture of the scientific facts... Acids in the West's snow, fog, rain, and dry air pose disturbing -- and increasing -- threats to the West's valuable commercial recreational resources. We now see that acid rain is a national issue, hitting both East and West."

This is in conflict with the recent report written by Dr. Bruch.*

> "The areas affected by acid rain in the West include some of the nation's most valuable -- and most publicly valued -- natural resources including Yosemite, Sequoia, Mount Rainier, North Cascades and Rocky Mountain National Parks. These parks and large tracts in the West are sensitive to acidic deposition and are known to be receiving it today."

Data contained in the report show that rainfall on these parks is not abnormally acid.

The WRI report also contains emission data which demonstrates that the emissions of SO_2 in the West have declined since 1970 to a level which is approximately the same as existed in 1960. The report also projects future SO_2 emissions in the year 2000 to be less than the total present in 1950. These WRI reported facts are in conflict with the general presumption that sulfates are increasing and are causing worsening acid rain the West.

Given these specific examples, we feel this Subcommittee should take it upon itself to form a commission of experts to sort fact from fiction and to provide guidance, not only for the public at large, but specifically for the Congress. We cannot continue to go forth with this scientific uncertainty. We need to know what is the cause, what are the effects and what to do to correct them. This uncertainty must be removed before Congress burdens the consuming public with the tremendous costs for additional pollution control without knowing what benefits, if any, will result.

Studies of regional air quality have been underway for many years. Studies of visibility such as VIEW, VISTTA, and SCENES all demonstrate that individual point sources are not appreciably affecting visibility in the national parks. Similarly, over a dozen acid rain research programs are being conducted in the West in several locations including Rocky Mountain National Park and the Sierra Nevada Mountains. None of these projects has shown any harm caused by acid rain in the West. Yet we are told by some that acid rain is threatening our parks in the West. We are caught between the proponents who continue to claim that damage due to air pollution in the West is happening today and the scientific facts which demonstrate no such environmental emergency.

In conclusion, WEST Associates is very concerned with the uncertainty and 'fiction before fact' atmosphere surrounding the issues of visibility and acid precipitation in the West. We are recommending that this Subcommittee establish a commission of experts to review credible scientific data that is currently available, to propose research as needed, and to analyze the results. This commission should be established by this Subcommittee with a charter to report directly to Congress. We will support the Subcommittee and the proposed commission in any way possible to advance the research and resolve these scientific uncertainties.

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THE IMPACT OF AIR POLLUTION ON NATIONAL PARK UNITS: A SUMMARY OF HEARINGS HELD BY THE HOUSE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION, MAY 20-21, 1985

Prepared at the Request of the
House Committee on Interior and Insular Affairs,
Subcommittee on National Parks and Recreation

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June 1985

PREFACE

The Environment and Natural Resources Policy Division, Congressional Research Service, has been requested by Chairman Bruce Vento of the Subcommittee on National Parks and Recreation to prepare a summary of hearings held in May 1985 on air pollution impacts on national parks conducted by the Subcommittee.

The summary which follows was prepared by George H. Siehl, Specialist in Natural Resources Policy; Adela Backiel, Analyst in Natural Resources Policy; Eugene Buck, Specialist in Natural Resources Policy; and Maria Grimes, Specialist in Environmental Policy.

The material cited is drawn entirely from testimony and information presented by witnesses during the two days of hearings. It should be noted that many quotations are drawn from the uncorrected transcript of the hearings; these were edited by CRS only to correct obvious spelling errors. Quotations from the prepared statements of the witnesses are also used.

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THE IMPACT OF AIR POLLUTION ON NATIONAL PARK UNITS: A SUMMARY OF HEARINGS HELD BY THE HOUSE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION, MAY 20-21, 1985

OVERVIEW AND INTRODUCTION

On May 20 and 21, 1985, the Subcommittee on National Parks and Recreation of the House Committee on Interior and Insular Affairs held hearings to receive testimony from public and private witnesses to determine the impacts of air pollution on units of the National Park System. Particular emphasis was given to the review of impacts on four types of park resources: (1) aquatic; (2) cultural and material; (3) vegetation and trees; and (4) visibility. Witnesses also provided information on additional subjects, including the possibility of harm to park visitors, the adequacy of the pollution monitoring system, and problems associated with the protections provided to the National Parks under the Clean Air Act, as amended.

Among those private sector sources offering testimony before the Subcommittee were representatives of environmental organizations, business organizations, and academic institutions. Testimony was received from Department of the Interior witnesses, including National Park superintendents and Park Service specialists and scientists engaged in research and monitoring air quality problems within the National Park System. Members of the House and Senate also offered their views on the subject. A full list of witnesses is included as an appendix to this summary.

Representative Vento's opening remarks provided an overview of the purpose and scope of the hearings:

> The purpose of these hearings most importantly is to establish what effects air pollution is having or may be reasonably expected to have on the natural and cultural resources of our park system.
>
> I have read the Congressional Research Reports that you have before you, and have attended the briefing that the National Park Service gave for Members and staff and I can tell you I am amazed at how widespread the effect of air pollution in the parks is. I am deeply concerned at the high level of vegetative damage already recorded from every region of the country, and wonder how it can get much worse.

He noted that the major questions are:

> How fast it will occur, what is causing the damage and what we can do about it.

The ranking Subcommittee minority Member, Representative Lagomarsino said:

> Although it appears that the bulk of the research conducted so far seems to indicate that our national parks have not yet been significantly damaged, there is no doubt the parks are very sensitive areas and probably extremely vulnerable to air pollution. As the Chairman pointed out, one of the points in setting up the parks in the first place was to preserve their pristine quality.
>
> Furthermore, you agree on the importance of examining the air pollution-acid rain issue at this time to determine whether additional action is necessary to preclude serious air degradation within our national parks.

Dr. Ellis Cowling included in his testimony two tables which described the air pollutants which are of major concern, and the impacts of these pollutants upon resources and human activities. The tables are included here as an Appendix I and provide a summary of the scope of what was discussed in depth during the two days of the hearings.

The phrase "acid rain" or "acid deposition" is currently much debated in the Congress; while this subject was included in the hearings before the

Subcommittee on National Parks and Recreation, the scope of the hearings included the effects of all forms of air pollution.

The complexity of the air pollution situation and the pervasiveness of its different manifestations led Representative Vento to inquire into the protective authorities available to the National Park Service (NPS). Specifically, he wished to have delineated the authorities the NPS might derive from the Clean Air Act and from the 1916 Organic Act for the National Park Service to protect parks from air pollution impacts. His question led to a dialogue with Ms. Molly Ross, head of the NPS air quality office, in which she indicated that the Park Service is unclear on the degree to which traditional remedies against nuisance and trespass provided in its Organic Act are undercut by existence of the Clean Air Act. She indicated that a Supreme Court decision on the Clean Water Act suggested this uncertainty. Mr. Vento then requested the Solicitor's Office of the Department of the Interior to provide the Subcommittee with an opinion on what it "believes is the authority that they have and the responsibility to deal with air pollution in these instances." The opinion was not yet available as this summary was prepared.

Recommendations of Witnesses

Witnesses presented a number of suggestions and recommendations during the two days of hearings. Many of these recommendations centered on the need for additional funding for monitoring and research to determine the extent and impact of air pollution within park system units. Several witnesses stressed the need for basic baseline inventories of park resources so that future changes could be noted and related to changes in air quality.

While the focus of the hearings was on the impacts of air pollution on park resources, witnesses and committee members noted that the cause of the problems was often far removed from the park boundaries and thus beyond the ability of park managers to control. Some witnesses suggested a number of changes in the Clean Air Act and its implementation as the means of reducing or eliminating these problems. Ms. Buffone, for instance, suggested in her prepared statement the importance of instituting emission reduction measures.

The need to deal with air pollution issues on a regional basis was noted several times during the hearings. Mr. James Lents, director of the Colorado Air Pollution Control Division, addressed this point and included it in recommendations to develop regional visibility and acid deposition standards and to involve the States in the standard setting process in addition to Federal land managers. He also recommended an accurate western inventory on "emission rates, existing levels of control on sources, and the potential for reasonable further control on each source."

While a number of speakers supported prompt action on additional legislative control of air pollution problems that are causing damage to the parks, there also were recommendations for caution. Mr. Green, representing WEST, recommended that "this subcommittee should take it upon itself to form a commission of experts to sort fact from fiction" so as to provide guidance for the public and for the Congress.

Contrasting recommendations were made on the designation of integral vistas, views associated with national park units, which are to be considered for protection in state air quality planning. Ms. Buffone recommended that Congress require the Interior Department to act quickly to finalize the preliminary list of such areas. Mr. White, on the other hand, recommended that Congress repudiate the concept entirely.

Monitoring of Air Quality in National Park Units

In connection with nearly every issue raised and with every source of air quality problems related to park resources, the need for improved monitoring and data collection was discussed. An overview of the current monitoring programs in effect in national park units emerged from the testimony in the hearings, and the summary of these programs that follows is presented as context for comments in the rest of this summary report.

The National Park Service (NPS) has been monitoring air quality in the national parks since 1970 in order to provide baseline data and to determine what changes may be taking place. The monitoring program is administered by the Air Quality Office of NPS. Both visibility and pollutants, such as sulfur dioxide and suspended particles are covered by the monitoring program. Dr. Richard Briceland, Associate Director of the NPS stated that monitoring is being done in 40 parks, 29 of which are Class I and 11 are Class II under the Clean Air Act definitions. The most widespread monitoring program is for aspects of visibility with 35 parks using cameras to capture changes in visibility.

Acting Director Mary Lou Grier listed the monitoring programs underway, as follows:

> It involves sulfur dioxide monitors at 11 parks, ozone monitors at 19 parks, total suspended particulate monitors at 16 parks, nitrogen dioxide monitors at two parks, a hydrogen sulfide monitor at one park, fine particulate monitors for visibility at 28 parks,

teleradiometers for visibility at 29 parks,
and cameras for visibility at 35 parks.
[p. 29; May 21]

The Air Quality Office also operates a biological effects program to study the effects of air pollution on vegetation. Begun in 1982, the program examines such specifics as trace element surveys, sensitivity screenings and ecological surveys. Activities under this program are being conducted in 35 parks in fiscal year 1985, with much of the actual work being done by specialists affiliated with universities, scientific laboratories and other Federal agencies.

The air quality office runs two technical programs. One analyzes permit applications for proposed new facilities that could affect the air quality of a park unit. The other program is developing a model for tracing and predicting the movement and concentration of air pollutants.

The Park Service also is cooperating in two multi-agency acid deposition activities under the National Acid Precipitation Assessment Program (NAPAP). The NPS is studying the effects of acid deposition on both cultural and aquatic resources. These efforts began in 1982 and have included 20 research projects on inventorying and monitoring sensitive cultural resources, studying the degradation process in materials, and seeking means of mitigating air pollution damage.

The aquatic component of the NAPAP project involves wet deposition monitoring in 27 areas and watershed research projects in 4 national parks. Cooperative studies are being done with the Geological Survey in the Rocky Mountains, Sierra range, and southern Appalachian Mountains. Other assessment projects are underway in the Great Basin to monitor the relationship between acid deposition and water quality and in the Pacific Northwest to monitor for effects from acid precipitation.

The specific monitoring and research programs are described in more detail in each portion of this report as they relate to the specific resources discussed.

ISSUES ASSOCIATED WITH AIR QUALITY IMPACTS ON AQUATIC RESOURCES IN NATIONAL PARKS*

Introduction

The discussion of aquatic impacts centered on perceptions of resource sensitivities to acid deposition in national parks. Limited research on this topic in national parks was reviewed. There was general agreement that aquatic resources in parks were sensitive to disturbance, but that alterations of aquatic chemistry had been observed at only a few park sites.

General Description of Aquatic Impacts and Sensitivities

The most comprehensive overview of air quality impacts on aquatic resources was presented by James Galloway, Associate Professor of Environmental Science at the University of Virginia. Dr. Galloway, who is conducting extensive research in Shenandoah National Park, summarized what is known concerning acid deposition and its effects on streams and lakes in the Western, Northeastern, and Southeastern regions of the United States. He reported that three things are required before biological effects of acid deposition on streams and lakes occurs: (1) existence of acid deposition; (2) stream or lake sensitivity to acidification such that lowering the alkalinity will cause reductions in biological populations; and (3) types of soils adjacent to or near a given stream or lake which will allow the acids to get into that stream or lake.

---

* This section prepared by Eugene H. Buck, Specialist in Natural Resources Policy.

For criterion 1 (acid deposition), Dr. Galloway explained that sulfuric acid deposition is much more evident in eastern North America. This explains why impacts are not severe in the West yet. "Certainly if (acid deposition) increases in the West, you will see regional scale acidification; all the models point to this." For criterion 2 (sensitive aquatic systems), these are found in all three regions. For criterion 3 (soils), Dr. Galloway explained that soils act as a barrier in the Southeast, but not in the Northeast, because the sulfur absorption capacity is greater in southeastern soils than in northeastern soils. "The bad news for the Southeast for the soils currently acting as a barrier to sulfuric acid is that it won't last very long. There is a finite reservoir of soil material able to soak up the sulfuric acid. . . . in one to three decades, we expect to see stream acidification occurring on a regional basis as we have seen in northeast United States." Dr. Galloway indicated that soils in the West will not retain sulfuric acid either, similar to the northeast.

Additional characterization of the West was provided by Mohamed El-Ashry, Senior Associate of World Resources Institute:

> . . . (thinner soils in the West) means that when acidic deposition falls on these mountains the acidic runoff can flow into the lakes and streams with little or no neutralization by the soils. Also, western mountains tend to accumulate more snow than do those in the East, and during the spring melt this can cause a brief pulse of acidity to the surrounding bodies of water. This pulse, coming as it does when ecosystems are just beginning to grow with the spring, can place both plant and animal species at risk at a critical time in their development. The problem of acid pulses is further complicated by the fact that many lakes in the West have low alkalinity, the property necessary to neutralize acidic deposition.

> This is especially true in many lakes in the Washington Cascades, the Sierra Nevadas, and the Rockies. [p. 36; May 20]

Specific concern was shown for an adequate understanding of the conditions under which aquatic invertebrate populations might be harmed or reduced. Superintendents James B. Thompson (Rocky Mountain National Park) and Robert C. Heyder (Mesa Verde National Park) indicated pH values of at least 5.5 were essential if insect larvae upon which many fish depend were to remain unharmed. Ray Hermann, Director of the National Park Service's Water Resources Field Support Laboratory, indicated the usefulness of lake coring:

> . . . we know quite a bit about some of the aquatic systems and their sensitivity to acidity. If you look at lake cores, for instance, the historical record, we can use diatoms in those cores as an assessment of acidification historically, going back and looking at what has occurred during the cultural revolution. [p. 209; May 21]

Sensitivities of Park Resources (by Park)

Sensitivities of aquatic resources in individual parks to alteration from air pollution (acid deposition) were mentioned in testimony by several persons. Dr. El-Ashry categorized western parks with sensitive aquatic resources:

> ten national parks and one national monument are in areas identified as sensitive to acidic deposition: in the Cascade Range, Mount Rainier, North Cascades, and Crater Lake National Parks; in the Coast Range, Olympic National Park; in the Sierra Nevadas, Yosemite, Sequoia, and King's Canyon National Parks and Devil's Postpile National Monument; in the Rockies, Yellowstone, Glacier, and Rocky Mountain National Parks. [p. 36; May 20]

Several superintendents commented on sensitivities in parks mentioned by Dr. El-Ashry. Concerning Olympic National Park, Superintendent Robert S. Chandler expressed fear of habitat loss for anadromous salmon and steel-head in 11 rivers which flow out of the park. For Sequoia and Kings Canyon National Parks, Superintendent Boyd Evison understood their aquatic vulnerability was related to thin soils and low buffering capacity. In Rocky Mountain National Park, Superintendent Thompson was concerned specifically for survival of a sensitive and threatened species of trout:

> One of the reasons for our concern there, aside from the general aquatic life in the park, is that we are the area where the threatened species of greenback cutthroat trout has been reintroduced. It was nearly extinct. And it is recovering. It is recovering primarily in the park. In fact, all of the areas where the greenback has been reintroduced as part of the recovery program are in these drainages that are susceptible to this kind of a condition. [p. 143; May 21]

Dr. Galloway characterized the sensitivities of aquatic resources in Shenandoah National Park:

> Half the streams studied and about a third of the total park have . . . watersheds containing streams that have low enough alkalinities such that we expect the acidification of streams to occur to such a degree that the watersheds so designated will have their biological populations in the streams affected in the next one to three decades. . . . We have seen the stream acidification, and we fully expect that you will see regional scale acidification in the next one to three decades. [p. 125; May 20]

John Peine, Director of the Uplands Field Research Laboratory at Great Smoky Mountains National Park, foresees similar problems for Great Smoky Mountains National Park:

> . . . within one or two or three decades, there is very likely to be a period of saturation of the sulfate in the soils. I think that is a potential time bomb possibly, in terms of the aquatic resources in these mountain streams. They are very vulnerable to acid deposition. They are very vulnerable to pH depression. If the soils become saturated, then there will be a much higher level of acidity going into those streams. It hasn't been proven to occur yet, but (Dr. Galloway's) studies certainly point to the potential in the future. [p. 123; May 21]

Janet Anderson, Forest Pathologist with the College of the Atlantic characterized her studies in Acadia National Park:

> We have also been involved in . . . a comprehensive study of the surface waters of (Acadia) park. We studied the five major watersheds in the park and this included sampling in 18 lakes and ponds and 23 streams and brooks throughout the four seasons of the year. We also took sediment cores from three lakes to give us an indication of historical trends in pH in these lakes. . . In the park the streams are vulnerable to continued acidic precipitation. Most of the island has bedrock and soils are thin so there is little to buffer the acids coming in, especially to the high elevation waters. The alkalinities are low and as we mentioned before, alkalinities are a measure of the water's ability to buffer the incoming acids. [p. 131; May 20]

Since geology of an area is important to assessment of its sensitivity to acid deposition, Chairman Vento likened the sensitivity of the Boundary Waters Canoe Area, Minnesota, with that reported for Acadia National Park. However, John M. Morehead, Superintendent of Everglades National Park, believes the prevailing limestone geology in his area provides a measure of protection:

> . . . because of the limestone substrate of Florida, we feel the acid precipitation that

> actually reaches the ground has very little, if any, damage to the flora and fauna. [p. 113; May 21]

Description of Monitoring Program

In Place

The existing monitoring program of the National Park Service was described by Mary Lou Grier, Acting Director of the National Park Service:

> the Service runs . . . long-term research efforts to study the effects of acid deposition . . . on aquatic resources. Funded in fiscal year 1985 at . . . $511,000 . . . Our research effort on the effects of acid precipitation on aquatic systems, begun in 1982, now involves a wet deposition monitoring program in 27 areas, and watershed research projects in four national parks--Rocky Mountain, Sequoia/Kings Canyon, Olympic, and Isle Royale. The service is cooperating with others including the U.S. Geological Survey, to study parks in the Rocky Mountain region, the southern Appalachians, and the Sierras. The Great Lakes Basin parks are being studied to determine how acid deposition correlates with water quality. Northwestern lakes and streams in Mt. Rainier and North Cascades National Parks are being monitored for effects from acid precipitation. [p. 30; May 21]

However, some of the monitoring activities related to aquatic resources are limited--Superintendent Evison reported that only one lake was monitored intensively at their site. Ray Hermann reported that lake coring has been done only in Rocky Mountain National Park.

Ray Hermann also described how the National Park Service participates in the National Acid Precipitation Assessment Program, which is the nationwide interagency effort. That involvement resulted in the establishment of the four intensive baseline research sites in national parks mentioned earlier by

Ms. Grier. Ray Hermann continued to state that the National Park Service had not yet developed any hard data from studies at these sites that would be able to say anything about effects in parks. These studies were characterized as long-term, extending through 1990 or 1992.

Additional aquatic resource monitoring conducted in or adjacent to national parks has been conducted by various private and academic organizations and was represented at the hearing by Dr. Anderson from College of the Atlantic, Dr. Galloway from the University of Virginia, and George Green representing Western Energy Supply and Transmission Associates.

Additional Monitoring Needs

Additional monitoring requirements were expressed in several ways. Chairman Vento expressed concern that monitoring was conducted at only 27 parks, but recognized the financial limitations in monitoring more units. Chairman Vento was also concerned that important aquatic species would be monitored:

> I guess the real problem here gets to be whether there is a continuing monitoring of aquatic species that is ongoing to determine an upturn or downturn in terms of those and what is the net effect in terms of increased pH in the water. Obviously, trout happen to be a pH-sensitive type of species.
> [p. 57; May 21]

Dr. El-Ashry twice expressed a need for additional monitoring relating to determination of aquatic environment sensitivities:

> more intensive and comprehensive research on the response of western watersheds to acidic deposition would help to determine future rates of chemical and biological changes in acid-sensitive ecosystems.
> [p. 39; May 20]

> the concern of scientists still remains on what happens when we put that acid in different concentrations on a watershed. Some will react differencly from others. And that is what they need to study. [p. 56; May 20]

Superintendent Evison expressed concern that additional monitoring of biological systems was needed:

> We need to do more work probably, in looking into the effects of acid precipitation on various elements, particularly the animal side of the ecosystem, from plankton in the lakes and invertebrates in the lakes and in terrestrial ecosystems all the way up through the vertebrates. [p. 104; May 21]

Impacts Reported on Specific Parks

Observed Chemical Impacts

Testimony was presented which identified changes in aquatic chemistry thought to be associated with acid deposition in six parks: Great Smoky Mountains, Sequoia, Shenandoah, Acadia, Rocky Mountain, and Mesa Verde National Parks.

At Great Smoky Mountains National Park, streams at higher elevations were reported to experience an increase in acidity after storms. In addition, Superintendent John E. Cook expressed a new concern:

> We are beginning to get some indication that there might some heavy metal. The very, very preliminary data was just made available to myself and my staff within the last few months. [p. 120; May 21]

At Sequoia National Park, levels of sulfate above what people believe to be the natural background have been observed in lake water at high elevations. Charles Epstein, Staff Scientist for the Environmental Defense Fund, clarified the situation at Sequoia:

> there are two studies, . . . one at the same Sequoia Park site in California, which indicate that episodic or short-term acidifications have occurred associated with spring-time high volume runoffs in which the natural buffering that may be otherwise available is quickly diluted, and for a short time the water body has extremely little or no remaining buffer capacity. [p. 98; May 20]

In addition, temporary total acidification of a lake was observed following a heavy July 1984 rainstorm as reported by Superintendent Evison:

> On at least one occasion in our high elevation study site there was, I think, a two-inch rainfall during the summer, during which time, as I understand it, the acidity didn't increase but the buffering capacity of the lake was reduced to virtually nil. Had that gone on for any longer or had it involved much lower pH, there could have been pretty severe changes in the lake ecosystem. [p. 100; May 21]

In Shenandoah National Park, the pH of waters in White Oak Run in the southern part of the park have been observed to have declined steadily during several years of study. This decline has been gradual due to the sulfate absorption capacity of park soils.

At Acadia National Park, Dr. Anderson reported results of research on aquatic impacts:

> From the sediment records of Acadia there is a suggestion that a gradual decline has occurred in pH and alkalinity over the past 100 years. We do have one acidic pond (Sergeant Pond) on the island but we cannot really predict when the major lakes and streams might become acidic. We have seen a few brooks (at higher elevations) already showing signs of acidification, especially in the spring and after heavy fall rains. The point to remember is that the reduction in pH and alkalinity is difficult to reverse. [p. 131; May 20]

However, Ray Hermann questions the Acadia data:

> We don't have any solid data out of Acadia (National Park) indicating acidification, however. [p. 209; May 21]

At Rocky Mountain National Park, Superintendent Thompson reported observations of pH depression to about 5.8 early in the spring when snow melt occurs, but no established trend in the actual pH level of high lakes. Subsequent to snow melt, pH again rises. However, Ray Hermann questioned that this indicated acidification:

> What we found with that evidence (from lake coring) is that the systems have not been acidified up to this point. [p. 209; May 21]

At Mesa Verde National Park, Superintendent Heyder noted pH as low as 5.8 in lakes along with other changes in aquatic chemistry:

> Throughout the winter, of course, there is . . . no significant water movement in those high altitude areas because everything is locked up in snow and ice. There tends to be a concentration. During the spring runoff, when it first starts, we get our lowest pH readings, which are down around 5.8. As the runoff continues later in the spring, then the pH levels go up to 6, 6.2, in that area. Apparently the flushing that takes place at a very rapid rate at these high lakes, with incoming water, begins to dilute these concentrations that have accumulated during the winter. We don't have anything in the actual pH of the lakes that could give us a trend at this point. [p. 149; May 21]

Observed Biological Impacts

During the course of the hearings, observations of biological impacts were noted at Great Smoky Mountain National Park and questioned at Everglades National Park. Direct inquiries into possible fisheries impacts were answered negatively for two other parks--Acadia and Grand Canyon National Parks.

Testimony presented by Senator Jim Sasser and Superintendent Cook focused on a reported fish kill. Senator Sasser characterized the event:

> . . . approximately 50,000 fish died at the Blankenship trout farm on Raven Fork Creek. The fishkills occurred during rains of one inch or more . . . [p. 11; May 20]

Superintendent Cook further clarified the occurrence:

> The fish kill Senator Sasser referred to took place outside of the Great Smokies. It is a trout farm operated by the Cherokee Tribe in North Carolina. However, Raven's Fork runs from within the Great Smoky Mountains. It is water that comes out of the park. TVA did do an evaluation of the cause of the fish kill. The determination was pH, or acid pH factor, did cause the fish kill. [p. 56; May 21]

Superintendent Cook stated that no evidence indicates fish kills "anything like" the magnitude of the Raven's Fork event occurring within the park. However, Chairman Vento pondered whether impacts within the park weren't likely:

> I suppose the inference is that, if . . . it's unhealthy for fish out of the park, it isn't too good for the ones in the park either. [p. 56; May 21]

Superintendent Cook did observe that other aquatic life responded to altered stream chemistry:

> We are finding in some studies we are just starting with salamanders that a high pH level in the stream following a rain, the salamanders hot-foot it for high ground. They want to get away from the pH factor. [p. 117; May 21]

In the Everglades National Park, Superintendent Morehead noted a questionable association of observed biological impacts with air pollution:

> we had an indication from a study back in 1973 and 1974 that some of the invertebrates and marine animals may have had high levels of mercury and arsenic. . . .

> I can't say that that heavy metal deposition found in the animals was due to agricultural spraying at that time or not. . . . I don't think that the heavy metal indicated by that study is a result of an existing air pollution problem. [p. 119; May 21]

Economic Factors

Only brief mention was made of potential economic loss related to aquatic impacts. Chairman Vento noted that the loss of trout in adjacent to the Great Smoky Mountain National Park indicates a cost arising from lack of mitigation for acidic runoff. Charles Epstein pointed to other potential costs:

> I think if you look at the State of Washington you fill find that the water supply for the City of Seattle is in fact one and the same with some of the high elevation waters in the Cascades. . . . There can be a direct connection between deterioration in drinking water quality and acidic deposition when the water becomes sufficiently corrosive to bring metals into solution, those derived from the soils surrounding the water bodies or metals in the delivery systems. [p. 114; May 20]

Additional Issues Identified

Issues related to aquatic resources were many and varied. Frustration at the inadequacy of protection afforded parks under current law was a basic concern expressed by Mr. Udall:

> We set aside all of these (parks) and . . . we find we maybe haven't protected anything, that the high mountain lakes in the Rocky Mountains will die, the trout streams in

> Utah, Colorado and Arizona may not survive
> this acid rain problem. [p. 32; May 20]

Concern for air pollutant source identity and relative contribution leading to degradation of aquatic environments was expressed by Representative Seiberling relating to new smelters in Mexico and Representative Hansen relating to sulfur dioxide emissions from southern Arizona.

Several persons suggested different issues related to impact assessment. Chairman Vento questioned whether we know enough about the natural processes neutralizing acid deposition in soils and water to understand how heavy metals may be mobilized. Superintendent Chandler expressed concern for identification of indicator organisms responsive to acid deposition impacts:

> from what I have read and from what our technical staff tells me, looking at some of the effects of acid rain in Norway and Sweden, where the populations have been really disturbed by or in some cases wiped out nearly by acid rain, it is again why we feel we need to have indicators to find out what might be happening to those aquatic systems.
> [p. 110; May 21]

Frustration at the lack of mitigation techniques was expressed by Dr. James Lents, Director of the Air Pollution Control Division, Colorado Department of Health:

> Is there anything that can be done to stop the decline in visual air quality and the potential acidification of our mountain lakes? Can some of it be recouped?
> [p. 178; May 20]

Finally, Chairman Vento expressed misapprehension concerning proposals for lake liming as a mitigation technique:

> I don't want to mislead anybody by saying we can lime lakes . . . to protect them, because that would not work. . . .
> [p. 83; May 20]

IMPACTS OF AIR POLLUTION ON FOREST AND VEGETATION RESOURCES OF NATIONAL PARK SYSTEM UNITS*

Overview

While damage to aquatic ecosystems from acid deposition was confirmed by most witnesses, the only definitive examples of vegetation damage due to air pollution was from ozone. The extent of ozone damage, its implications, and potential vegetation damage from other air pollutants are currently being studied.

Forest decline has been observed both in the United States and Europe, but has not been conclusively linked to air pollution. Forest damage and decline is considered, however, the most threatening potential effect of air pollutants on vegetation not only within park units, but for all public and private forestlands, because of the potential economic impacts on commercial tree species, and the aesthetic values of forests, particularly for parks.

Major Issues Identified

The major issues that emerged from the witnesses' testimonies involved primarily research and monitoring. Park Service officials and private individuals alike urged acquiring additional inventory and baseline data so that better judgments can be made regarding the progression of pollution effects. Although most witnesses described specific effects of ozone pollution, it is not yet possible to project the decrease in ozone that would be necessary to stop the damage from occurring. The role of acid precipitation, and the potential combined effects of multiple pollutants, is not yet known. And because of these deficiencies, it is very difficult, if not impossible, to estimate the economic impact--for both commercial endeavors and aesthetic value--of pollutant damage to vegetative park resources.

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*This section prepared by Adela Backiel, Analyst in Natural Resources Policy.

The primary question, which was asked repeatedly throughout the hearings, is when do we know enough to act? Not many witnesses felt comfortable answering this question with respect to vegetation resources. However, Dr. Mohammed El-Ashry of the World Resources Institute believes that there is already enough general information to warrant some type of pollution control program:

> My personal view is that we know enough about what is causing acid rain and where it is coming from to formulate an acid rain control strategy by reducing the emissions that are known to cause that acid rain from the sources that are mostly contributing to it. The target for that reduction. . . I think can be discussed and can be resolved. But the control program, I believe, is one that is warranted based on the knowledge we have at this time.

General Air Quality Impacts on Forests and Vegetation

Forests

Information on existing and potential damage to forests from air pollution, specifically in national park units, is in many cases only preliminary. The more general picture with respect to air quality impacts on forests was the focus of much testimony in the hearings, because effects on all types of vegetation are likely to be relevant to forest and vegetation resources within the parks.

The most comprehensive overview on the possible role of airborne chemicals in the damage and decline of forests was presented by Dr. Ellis Cowling, Associate Dean for Research at North Carolina State University and Director of the Acid Deposition Program.

Many regional forest declines have been observed over the past 200 years in both North America and Europe. The most important of these declines is the current "Waldsterben," which means "forest death," that is being observed in West and East Germany, Czechoslovakia, Austria, Poland, Switzerland, France, Italy, and Sweden. This decline is considered the most important for many reasons: the large geographical area affected; the large commercial and aesthetic value of the declining forests; the diversity of ecosystems in which the decline is observed; the unique symptoms of declining trees, several of which have not been previously witnessed; and the fact that it is the first that affects multiple tree species along with herbs and shrubs of the forest ecosystem.

Dr. Cowling stated that North America has not witnessed a decline of the intensity of the Waldsterben, although there are several similarities between the declines observed in North America with those in Europe. These similarities, along with the differences, are summarized in Table 1, submitted by Dr. Cowling. The major similarities include: yellowing of foliage, progressing from lower to upper parts of the canopy, and from the inner to the outer portion of branches, with the oldest tissues affected first; decreases in diameter growth of conifers on both continents, although growth effects being more gradual in Europe than in North America.

The major differences between the declines on the two continents are described as including: a greater frequency of dying back from the top--youngest tissues effected first--in North America than in Europe; the greater frequency of abnormal growth symptoms in Europe; a variety of symptoms found in Europe that don't exist in North America (see Table 1 for specifics); and the greater frequency of decrease in growth without other visible symptoms of damage in North America.

The reason for the declines currently being experienced in both Europe and North America has not been firmly established within the scientific community, although many hypotheses exist. Dr. Cowling stated that it is generally believed that the declines are the result of the "combined action of several different competitional, biological, physical, and chemical stress factors that act simultaneously or sequentially to induce the symptoms of damage." Additionally, he indicated that a "consensus of informed judgment" is developing that might order the importance of the chemical stress components as ozone, nitrogen compounds, phytotoxic gases (including sulfur dioxide--SO2), toxic metals, and wet and dry acidic deposition.

Of the declines currently being experienced, Dr. Cowling listed only four cases where airborne chemicals are considered to be a major causal factor, although the quality of evidence varies greatly: Waldsterben in the softwood and hardwood forests of Europe; Jeffrey and ponderosa pine in the San Bernardino Mountains of California; white pine decline in the eastern United States; and red spruce and Fraser fir in the Appalachian Mountains extending from Maine to North Carolina.

In summarizing the role of air pollutants in forest decline, Dr. Cowling stated that:

Table 1. Comparison of Symptoms of Decline in Forests of Europe and North America

Symptoms	Europe	North America
Growth-decreasing symptoms:		
1. Yellowing of foliage from the lower to the upper and from the inner to the outer portion of branches -- oldest tissues affected first.	Observed mainly in white fir and Norway spruce at high elevation.	Observed with white fir in the San Bernardino Mountains and recently in red spruce in New England and the southern Appalachians.
2. Dying back from the top of trees -- youngest tissues affected first.	Common in oak and ash, less common in birch and beech.	Conspicuous in red spruce, maple and oak declines; ash and birch diebacks.
3. Increased transparency of crowns due to gradual loss of leaves but with leaves retained to the very top of the trees.	Observed in Norway spruce, white fir, Scots pine, larch, beech, birch, oak, maple, ash, and alder.	Observed only in the littleleaf disease of shortleaf pine and in the beech-bark disease.
4. Losses of fine-root biomass and mycorrhizae (beneficial symbiosis between tree roots and soil fungi).	Common in white fir, Norway spruce and beech. Not studied in other species.	Observed mainly in red spruce and Fraser fir declines, birch dieback, and little leaf disease.
5. Synchronized decrease in diameter growth without other visible symptoms.	Not reported in Europe.	Observed in pitch pine and shortleaf pine.
6. Synchronized decrease in diameter growth with other visible symptoms leading to death.	Not reported in Europe.	Observed in red spruce and Fraser fir mainly at high elevation. Also ponderosa pine and Jeffrey pine.
7. Progressive decrease in diameter growth with other visible symptoms leading to death.	Studied mainly in Norway spruce, white fir and beech. Not studied in other species.	Observed in ash and birch diebacks, some maple and oak declines, sweetgum blight, littleleaf disease, and pole blight.
8. Death of herbaceous vegetation beneath some affected trees.	Observed in high elevation spruce and medium elevation beech forests.	Not observed in North America.

Symptoms	Europe	North America
Abnormal-growth symptoms:		
9. Active casting off (abscission) of leaves and shoots while still green.	Common in spruce, fir, and beech, ash larch, Scots pine, maple, and oak.	Reported only twice in North America, in loblolly pine and red spruce.
10. Change in relative length of long shoots and short shoots.	Common in beech and larch.	Reported only in the mycoplasma-induced "yellows" of ash.
11. Stork's nest crown formation in white fir	Common in white fir.	Not reported in North America.
12. Concentration of leaves in tufts or clumps at tips of branches.	Common in oak and ash.	Observed in nearly all declines of broad-leaved trees.
13. Change in size and shape of leaves.	Common in beech, occasionally in spruce, fir, birch, and oak, and Scots pine.	Common in white pine, littleleaf disease of shortleaf pine, and some maple and oak declines.
14. Excessive production of adventitious (out-of-place) shoots on branches.	Common in Norway spruce, White fir, and larch.	Observed recently for the first time in high altitude conifers. Common in maple and oak, ash, and birch.
15. Excessive production of seeds and cones.	Common in spruce, fir, beech, and birch; often observed several years in a row.	Observed in many stressed trees but mainly one year at a time.
General observations:		
Many different species suddenly showing substantially similar symptoms.	Yes.	No.
Commercial forests showing extensive decline.	Yes.	Yes.
Soil relationships.	Trees affected on nutrient-rich and nutrient-poor soils, acid soils and basic soils.	Trees affected more on nutrient-poor and acid soils.

General observations continued:

Elevation relationships.	Needle-bearing trees affected at all elevations.	Needle-bearing trees affected mainly at high elevation.

Symptom 3 has not been reported before 1979 affecting more than one species of trees.

Symptoms 8, 10, 14, and 15 have not been reported before 1980 affecting any tree species.

Symptom 9 has been reported only twice in North America and not before 1979 in central Europe.

> . . . it is widely assumed (and I think correctly so) that air pollutants and/or acid depositon are among the stress factors that have caused, or are contributing to, the symptoms observed in the forests of central Europe and in the high elevation forests of eastern North America. But these ideas are still only hypotheses; they have not been proven beyond a reasonable doubt.

Although Dr. Cowling thought it inappropriate to assume that the changes taking place in Germany are the same as those taking place in the United States, Dr. Mohammed El-Ashry of the World Resources Institute foresaw a potential problem for North American forests that could be drawn from the German experience in forest decline:

> When onset of damage occurs, rapid and extensive deterioration could follow. This has been the pattern in the damage to West German forests whereby in 1982 an estimatd 8 percent of the forests were reported as damaged, and by 1984 the figure had climbed to 55 percent.

Consequently, Dr. El-Ashry stated that;

> There are certain things that we know that would certainly benefit from [air pollution] controls. Reducing nitrogen oxides in southern California clearly benefit, the trees and the other ecosystems in Yosemite and in Sequoia, if not from acid rain at least from ozone, where there has been damage already from ozone to the trees in southern California.

He also anticipates that the smelters in Arizona contribute to the sulfur deposited on the western slope of the Rocky Mountains, in addition to large power plants in the Four Corners region.

Other Vegetation and Agricultural Crops

Testimony was also given that plants other than trees can also be affected by degradation of air quality. Some plants are more sensitive than others and can act as an indicator of the presence of pollutants. Lichens, as explained by Susan Buffone, Clean Air Program Coordinator for the

National Parks and Conservation Association, are pioneer plants that grow under very adverse conditions and require little moisture, and can be used as a bio-indicator species for high levels of sulfur dioxide air pollution. In some areas, pollution has affected the lichen populations to the point that they do not exist anymore; these areas are known as lichen deserts.

Just as lichens are considered good indicators of acidic deposition, milkweed, eastern white pine, wild grape, and a number of other species are considered indicators of ozone as noted by National Park Service scientists and other witnesses.

Ms. Buffone stated that one of the major problems with projections of future effects from various pollutants and pollution levels was knowing the current status of plants within the various parks:

> In order to know what they are to do in order to project the effects. . . we need the NPS to inventory existing flora and fauna to be able to find if there is an adverse impact.

The example she gave was the NPS looking at lichens in Teddy Roosevelt National Park in North Dakota to determine whether or not existing levels of air pollution is harmful. The problem, she said, is that NPS has "no basis on which to judge what the lichens were 10 years ago," making it difficult to explain how air pollution affects individual lichen populations.

O. Clifton Taylor, Professor of Plant Sciences at the University of California, Riverside, has been studying the affects of air pollution on various plants for numerous years. With respect to acid deposition in the West, he testified that "To my knowledge, there is no evidence of acid deposition injury to vegetation in the West in any general sense," only at specific sites close to local pollutant sources.

But Dr. Taylor has seen direct evidence of ozone damage to trees and agricultural crops. Agricultural crop losses, including lemons and naval oranges, vary from year to year depending upon climatic conditions. "Ozone and natural smog was responsible for about a 50 percent reduction in the grape crop" during 1978 and 1979. Consequently, Dr. Taylor says that for some crops, cotton for example, species are being planted based on their resistance to ozone.

Dr. Taylor is not only studying crops, but he is also doing fumigation studies on epiphytes to determine susceptibility to ozone and sulfur dioxide. In addition, during 1958-59 fumigation tests were run with pine seedlings which led to a project started in 1973 with the Environmental Protection Agency to look at the total ecosystem in San Bernardino National Forest. As a result, it was discovered that ozone damage facilitated other types of injury in this instance:

> Around 6,000 foot elevation and 70-100 miles east of Los Angeles, ozone injury increased pine bark beetle damage, increased root rot from organisms and very significantly incrased fire hazard and discouraged new seedling growth. Therefore, ozone caused an overall change in the populations of trees in the forest. Many weed trees tend to take over from the commercial type.

Effects on Specific National Park System Units

Dr. James Bennett, the National Park Service's chief scientist on air quality effects on vegetation, presented overall information regarding NPS research efforts and general effects on trees and vegetation in the parks due to air pollution. Major park vegetation effects and the status of NPS biomonitoring research studies are summarized in two tables submitted by NPS for the record and included here as Tables 2 and 3, respectively: Known Air Pollution Effects on Vegetation in National Parks, and Biomonitoring Studies. These tables should be referred to for specific species and park-by-park information. Overall vegetation effects, and some of the current park monitoring, research efforts, and data, given in both oral and written testimony, are described below.

With regard to overall NPS monitoring of biological effects, Dr. Bennett stated that "we have only covered about 1/4 or 1/5 of the parks that probably need the kinds of plots and projects that we have been doing." As a result, Dr. Bennett thought that NPS was not ready yet to do modelling:

> We need so much more baseline information, basic information on sensitivity of species; more baseline levels of information of the most important pollutants for vegetation. For ozone and sulfur dioxide--if we knew their concentrations--we could make some sort of judgements about potentials for effects on vegetation in those parks.

John Peine, Director of the Uplands Field Research Laboratory in Great Smoky Mountains National Park explained the uncertainty by stating:

> It becomes very complex to fix a scenario beyond the initial discovery of the symptom to what the ultimate potential survival rate of the species might be.

Biomonitoring is a major NPS effort to recognize vegetative effects due to pollution. As described by Dr. Bennett:

> NPS uses extremely sensitive species to indicate the onset of a small increment of pollution into a park . . . Lichens, milkweed, are the first species to go or to show sensitivity, before the things like the effects on spruce. If we use those--the canary in the mine approach--to indicate the onset of it, we will hopefully get information before . . . catastrophes will occur.

TABLE 2. KNOWN AIR POLLUTION EFFECTS ON VEGETATION IN NATIONAL PARKS

May 1985

The Biological Effects Program of the National Park Service's Air Quality Division, begun in 1978, includes the following categories of projects:

Effects Survey: Determines symptoms of air pollution injury on sensitive species and determines geographic extent, severity, and types of effects. May also include installation of biomonitoring plots and lichen surveys.

Sensitivity Screening: Determines what species are sensitive to expected air pollutants using dominant species, bioindicator species, rare and endangered species, and lichens. May be done in the laboratory or the field.

Trace Element Survey: Same as Effects Survey but the focus is on accumulations of toxic trace elements in park food chains.

Ecological Survey: Determines extent, severity and type of effects on plant communities containing large abundances of air pollution sensitive species. Requires installation of permanent plots.

What follows are the results to date of various projects of the types listed above funded by the National Park Service that demonstrate air pollution effects on vegetation in the indicated park units. Although all the following studies demonstrate vegetation effects, they are organized below under two general subheadings, "Effects Studies" and "Biomonitoring," that reflect differences in study approach and purpose.

Effects Studies

The following results come from various projects of the types listed above, collectively called "effects studies", that examine air pollution effects on vegetation as well as monitored concentrations of pollutants. The pollutant concentrations reported below are from NPS monitors physically located in national park units.

Park	Pollutant	Vegetation Effects
Acadia NP	Ozone (Four exceedances of NAAQS* in 1983 & 1984; the maximum hourly average during these years has been 0.14 ppm.)	Of 300 eastern white pine trees studied in 1984, 58% showed some slight ozone injury. A few ind viduals showed severe ozone inj thorougout the entire canopy. T injury appears to be correlated with decreased width of tree rings, i.e. growth.

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* National Ambient Air Quality Standards (NAAQS):

Ozone: 0.12 ppm/1/hour/1 day

Sulfur Dioxide: 0.50 ppm/3 hour
0.14 ppm/24 hour
0.03 ppm/annual average

Park	Pollutant	Vegetation Effects
Shenandoah NP	Ozone (No exceedances of NAAQS since 1980; however, maximum hourly averages during summers reach as high as 0.12 ppm; monthly means are increasing by .003 ppm.)	Widespread ozone injury in 1982 and 1984 on white pine, tulip poplar, black locust, wild grape, clematis and milkweed. These species were selected for study because they represent diverse parts of the ecosystem and they were known to be ozone sensitive. Injury on the most sensitive species (milkweed) occurred on 90% of the plants observed each year. About 8% of the least sensitive species (black locust) were injured. The injury appears to be correlated with decreased productivity and plant diversity. A survey of trees at elevations above 3000 feet revealed abnormally high mortality of some species.
	Sulfur oxides and heavy metals (Levels of sulfur dioxide are about 20% of the 3 hour NAAQS and 30% of the 24 hour NAAQS.)	Elevated concentrations of sulfur and lead are found in lichens. At some sites, the concentrations are above the normal range for lichens from unpolluted areas. Such concentrations have been associated with lichen decline and food web effects in other studies.
Great Smoky Mountains NP	Ozone (Data collected by TVA show numerous exceedances of NAAQS; however, latest data collected by Tennessee show attainment of NAAQS.)	Between 25-30% of eastern white pine trees show ozone injury. Preliminary evidence indicates that sensitive genotypes may be disappearing and that growth is decreasing.
Saguaro NM	Ozone (No exceedances of NAAQS since 1982; hourly average has reached .110 ppm during the summer.)	Almost all of 225 ponderosa pine trees studied in 1984 showed some ozone injury, with the average foliar injury being almost 12%. Some slight ozone injury was also observed on oak and walnut trees.

Park	Pollutant	Vegetation Effects
Sequoia NP	Ozone (The maximum hourly average during the summer has consistently exceeded or equalled NAAQS since 1981.)	Over one-third (36%) of 540 ponderosa pine trees studied periodically since 1980 show moderate to severe ozone injury. Injury is also common on oak trees. Foliar symptoms, like ozone injury observed in laboratory studies, have been recently observed on giant sequoia seedlings in the park.
Santa Monica Mountains	Ozone and sulfur dioxide (Summer 1984 ozone levels exceeded NAAQS on numerous occasions with the highest hourly average being 0.22 ppm; currently, no sulfur dioxide monitoring is being conducted in the park.)	A study of all types of foliar injury on 7 selected species showed that air pollution injury averaged 40% of all injury. The injury has been related to reduced biomass production which probably destabilizes soil and increases fire fuel loading. In portions of the park, lichens are no longer found ("lichen desert"), indicating long-term exposures to sulfur dioxide.
Indiana Dunes NL	Ozone and sulfur dioxide (Numerous exceedances of ozone NAAQS since 1983; highest ozone hourly average recorded has been 0.16 ppm; sulfur dioxide concentrations are 73%, 64% and 47% of 3 hour, 24 hour, and annual NAAQS.)	Foliar ozone injury is common on 16 species studied in 1984 including white and jack pines. Ozone injury is greater on juvenil than adults. Growth of jack pine juveniles and white pine adults is reduced in areas highest in ozone. A "lichen desert" also exists here indicating long-term exposures to sulfur dioxide.
Cuyahoga Valley NRA, Saratoaga NHP & Acadia NP	Ozone	In a simultaneous fumigation exposure study, ozone injury on quaking aspen genotypes from these parks was significantly less than injury on aspen genotypes from Voyageurs & Isle Royale NPs, which are more remote and probably less polluted, indicating that sensitive genotypes are probably absent, thus diminishing the species gene pool

TABLE 3. Biomonitoring Studies

The following parks are either exhibiting elevated concentrations of the indicated elements in biosphere organisms or components, or frequent foliar injury from gaseous pollutants. The ecological significance of these effects is unknown but it does indicate that the elements or pollutants are above normally expected levels and that man-made influences are present.

Park	Pollutant	Biosphere Organism or Component
20 Eastern Parks	Ozone	Common milkweed: foliar injury.
Hampton NHS Gettysburg NMP Fredericksburg/ Spotsylvania NMP Petersburg NB	Ozone	Black cherry, white ash, wild grape, sassafras, tulip poplar, dogwood, milkweed, witchhazel, redbud, white pine, Austrian pine: foliar injury.
Isle Royale NP Theodore Roosevelt NP Everglades NP Shenandoah NP Great Smoky Mountains NP	Sulfur	Lichens: abnormally high concentrations.
Shenandoah NP	Lead	Lichens: abnormally high concentrations.
Great Smoky Mountains NP	Lead	Leaf litter: abnormally high concentrations.
Big Thicket NP	Sulfur, heavy metals	Spanish moss: abnormally high concentrations.
Mt Rainier NP	Arsenic	Subalpine fir foliage: abnormally high concentrations.
Great Smoky Mountains NP	Heavy metals	Red spruce: abnormally high concentrations in tree rings.

David Parsons, a Sequoia National Park scientist, described some of the limitations and frustrations of current research and inventory results.

> Dr. Bennett's work on effects has tried to look at what is known to be the most sensitive species. But when you are dealing with a park that has thousands of plant species and you've only looked at a half dozen or a dozen, you can't really be sure what you might be missing.

NPS research efforts also include forests and trees experiencing decline in productivity. Dr. Bennett stated that there are "33 plots of eastern white pine in Great Smoky Mountains National Park to monitor for low level effects of ozone." To help define the role of ozone in the red spruce decline, Dr. Bennett states that NPS is fumigating red spruce this year for ozone sensitivity and should have some results by the end of the year. As Dr. Bennett stated, much of the scientific community believes that the "red spruce decline is thought to be due to a complex of pollutants, including acid rain and ozone and heavy metals."

With respect to damage to ponderosa and Jeffrey pines in the West, Dr. Bennett stated that over 1/3 of the ponderosa pine studied since 1980 show moderate to severe ozone injury. Dr. Bennett described ozone injury:

> [It] appears as a form of yellowing of the foliage, of the needles, and a kind of burning at the tips of the foliage . . . called tip burn. Allowing this condition to continue weakens the tree, slows down its growth, predisposes the tree to greater infestation by pests and diseases. In general, it causes an earlier demise of the tree. . . . These symptoms are diagnostic of ozone; they are only caused by ozone. When you see them on the foliage, you know that nothing else can cause those kinds of symptoms but ozone.

NPS also relies on research by other public and private entities. For example, the Oak Ridge National Laboratory (ORNL) conducts research in the

Great Smoky Mountains, with many results having implications for park resources. Dr. Bennett described an ORNL study analyzing heavy metals in tree rings.

> During periods of activity at the smelter south of the [Great Smoky Mountains National] Park, heavy metals [lead, mercury, iron] were elevated in the tree rings and growth decreased during those same periods.

Dr. Bennett also stressed the usefulness of cooperative research and extension efforts, such as with Dr. Taylor from the University of California, Riverside, but also cautioned that

> We can't do everything in the laboratory. If we want to make a case for effects on parks we have to do the work in parks.

Activities and Effects in Specific Parks

Scientists at both Great Smoky National Park in Tennessee and Sequoia National Park in California agreed that the number one problem facing both these parks is air pollution.

Sequoia National Park

Boyd Evison, Superintendent of Sequoia and Kings Canyon National Parks, stated that one third of the Jeffrey and Ponderosa pines are showing ozone damage, and also attributed the black oak damage in these parks to ozone.

> I believe that the only kind of air pollution that we can safely say is directly a cause of damage to resources in the park is ozone. . . One of the things that distinguishes our problem from that of most of the other forests is that most of it seems to be home grown . . . from the San Joaquin valley and as far north as the bay area; quite a bit of it from Fresno.

His major concern is that air pollution may be affecting the Giant Sequoias. David Parsons of Sequoia National Park spoke of current research on Sequoias:

> when fumigated with ozone, Sequoia seedlings do show ozone-like symptoms. That work will be replicated this summer up in the park . . . to see whether it is extraplicable.

However, Parsons also questions the use of fumigation studies because they are on young trees of one- to three-year-old seedlings.

> What we really don't know, with all of these fumigation studies, is how does that apply to mature trees out in the forest, and that's a whole other question.

To explain the difference between fumigation studies and field ecosystem studies, Parsons stated:

> As a plant ecologist I firmly believe that there are a number of stress factors acting on the Giant Sequoia as well as the associated species. It grows in a very similar habitat to the Ponderosa pine, where the damage has been found. There are a number of stress factors, both natural stress and unnatural stress. I think it is very difficult to to sort these out. I think we have to look at the ecology of the species we are talking about. We have to try to understand what the natural stresses are.

Superintendent Evison stated that most of the monitoring work occurring in Sequoia National Park was being done by people outside of NPS as part of a large cooperative effort. Sequoia Park scientist Parsons noted that the "Federal dollars coming through the Park Service are actually a very small portion of this." The majority of funds are from the State of California with additional funds from other Federal, state and private entities. In the park are several monitoring or research efforts: stations measuring wet precipitation and some preliminary studies on dry deposition; two additional samplers dealing with acid precipitation run by the California

Air Resources Boards at low and high elevation sites; and various ozone monitoring sites. In the past, SO2 has been monitored at the lower elevation site and had given an indication that there was no severe problem in those areas. Also, high volume particulate samplers have in the past been placed at low and mid-elevation sites in Sequoia National Park, also as part of the California Air Resources Board network.

Great Smoky National Park

Senator Jim Sasser of Tennessee described a rapid decline of red spruce in the eastern States since 1970; as many as 60 percent of these trees at higher elevations may be affected. Susan Buffone of the National Parks and Conservation Association cited statistics that show 80 percent of red spruce found at higher elevations in the Great Smoky Mountains are in severe decline; at lower elevations, 40 percent of the red spruce are affected.

Superintendent John Cook of Great Smoky National Park used pictures of red spruce tree rings to exemplify the red spruce decline. NPS scientist John Peine described the symptoms of declining red spruce as a:

> . . . great decline in the growth rate [as observed in] the rings, the dieback from the top of the tree, and the thinning from the inside out of the needles. We see that particularly at the very high elevation, around the Clingman's Dome Area, about 80 percent of the trees exhibit some form of this. It drops down to 40 percent at the lower elevation.

Mr. Peine also described the potential effects of this red spruce decline on the forest ecosystem, which indicate that it may be a precursor of more severe damage or death of the trees, with effects on other life forms:

> This tree [red spruce] is co-dominant with the Fraser fir that is under siege by the balsam aphid. The mortality there is very high. . . . I think that these two co-dominant species are under quite a bit of stress. If you look at the lessons of Europe, when the trees exhibit this nature and this degree of stress, it isn't a matter of all that many years, four to five years, before it follows with a fairly high rate of mortality. . . . Because [red spruce] is dominant it drives the ecosystem. So, all the other herbs and the small mammals and everything else that live in that environment are likely to be affected because of the fact that you are dealing with the two dominant tree species in that high elevation. . . . Many scientists believe [the reasons for the gradient by elevation] are related to cloud interception at the mountain tops and the fact that the clouds are heavily laden with pollutants that are potentially many times greater than what you might find in acid rain.

Superintendent Cook indicated that preliminary data suggests that heavy metals might be entering the area from the air. Monitoring for these and other air pollutants is ongoing in Great Smoky National Park through 120 air quality related studies and 35 scientific studies. The NPS expenditure in the park of $300,000 a year is augmented by cooperative efforts with institutions such as Oak Ridge National Laboratory, Tennessee Valley Authority, University of North Carolina, the State of Tennessee, to total about $8 million worth of scientific study.

Olympic National Park

Robert S. Chandler, Superintendent of Olympic National Park, states that they are not aware of any existing indication of plant damage from air pollution within park boundaries. However, there are efforts to try to get baseline data for those park resources. There are currently four different types of air quality monitoring underway there: visibility; the acid rain network (National Acid Deposition Program, NADP); air pollution assessment effort on the western slopes of the Olympic Mountains (which he stated has some of the cleanest air in the monitoring system); and a state run station managed by the Olympic air pollution control authority.

Shenandoah National Park

Robert R. Jacobsen, Superintendent of Shenandoah National Park, stated that a definitive decline in white pines has been established for a few years, and that:

> This is caused directly by ozone, with the episodes of high ozone being immediately traced back to tip burn.

In addition to the white pines, Superintendent Jacobsen said leaf spotting is very prevalent on milkweed, grape, yellow poplar, clematis, and a couple of other forest plants. Although no decline in population numbers has been observed, an elevated level of sulfur has been detected in park lichen populations. Mr. Jacobsen summarized his beliefs about how air pollution is affecting vegetative life:

> Ozone is affecting us right now. But in the long run I think acid precipitation is the one that is going to change the soil and its ability to support plant life.

Air quality monitoring has been carried out in Shenandoah National Park since 1976. Superintendent Jacobsen described the three monitoring stations in the park: in the northern, middle and southern regions of the park. Data are collected on a daily basis; data for ozone and sulphur dioxide are collected hourly. Three additional monitoring stations will be installed this summer at the same latitude but different elevations to help determine whether there is an altitudinal gradient of pollution, particularly ozone. Research in this park, too, has apparently found more damage at higher elevations. The park has also been involved in a number of monitoring programs conducted by other research organizations and programs, including the FORAST program sponsored by Oak Ridge National Laboratory, and is exploring the possibility of establishing acid fog monitoring devices in conjunction with the University of Virginia.

Acadia National Park

In Acadia National Park in Maine, "the ozone threat seems to be the greatest threat to the vegetation," according to Ronald N. Wrye, Superintendent of the Park. This judgment was based predominantly on results from a survey made last summer on effects of ozone on eastern white pine done by Dr. Janet Anderson, a plant pathologist from College of the Atlantic in Bar Harbor, Maine. A follow up study in 1985 will attempt to correlate the ozone effects. According to Dr. Anderson, the ozone levels in the park cause visible damage:

> enough to reduce visibility and cause yellow flecking on the needles of the white pine. For some it was toxic enough to cause necrosis which is death of the needles and the needles would turn brown. If this kind of injury continues, our trees will definitely weaken to the point where they would be attacked by insects and pathogens and they will be killed.

Dr. Anderson also described the consequences of this damage for Acadia National Park.

> The commercial forester is concerned with timber productivity, but the management at Acadia is concerned with the quality of the experience for the visitors. Air pollution, acidic precipitation, may reduce visitor experience by reducing the visibility, causing injury to pine trees and threatening aquatic species.

In addition to projects designed to evaluate effects of pollution on tree growth patterns of eastern forest trees, Dr. Anderson is conducting studies of lichens. These studies have resulted in the discovery of ten sulphur dioxide sensitive lichen species in the park which leads Dr. Anderson to the assumption that "sulfur oxide levels are low in the park." When asked about the source of the pollution, she said that with regard to ozone, the State estimates that 1/3 is from natural occurring sources, 1/3 from local emissions, 1/3 due to long distance transport.

Rocky Mountain National Park

James Thompson, Park Superintendent, indicated that ponderosa pine is beginning to show some damage from ozone in Rocky Mountain National Park in Colorado. A study to measure these effects is being initiated this summer. Superintendent Thompson reports that the park has been taking visibility readings and monitoring fine particulates for approximately five years. In addition, there are two National Atmospheric Deposition Program (NADP) sites in the park, one at park headquaters and one in the backcountry at an alpine lake.

Everglades National Park

John Morehead, Superintendent of Everglades National Park in Florida, is

> concerned about potential aspects of acid rain on the epiphyte plants, the orchids and lichens. We have recently started studies to measure those effects.

The Everglades has two monitoring stations: one, initiated in May 1985, to monitor levels of sulfur dioxide and ozone; and, one which has been functioning since 1980 to monitor acid deposition.

Economics

The only example of attempts to quantify the economic impacts of air pollution effects to vegetation was given by Dr. Taylor of the University of California at Berkeley. The National Crop Loss Assessment (NCLA) tries to estimate how many billions of dollars are lost nationally due to pollution.

Dr. Bennett of the National Park Service questioned the applicability of this type of program to estimate effects other than on agricultural crops.

> The NCLA project is aimed at estimating dollar losses from crops. This kind of work is done by exposing single varieties of crop plants to controlled amounts of pollution. In national parks and in wilderness areas we cannot use plants that way. What we have are mixtures of different types of varieties of any one species. The park is made up of many, many different types of what are called genotypes for each one of these species.
>
> One of our most recent studies has generated evidence that the most long-term effect that we are finding in the national parks now is an evolutionary one. We are finding that the populations of species in our most polluted parks are not as sensitive anymore as the the populations of the same species from our less polluted parks. We interpret this to mean that evolution has occurred. Selection has taken place against the sensitive individuals or genotypes of those species in those parks.
>
> We can't get at that--put a dollar value on that like they can in the NCLA project. This is a much more insidious effect and a much more difficult one to get a handle on. But we are getting evidence that it is taking place.

One of the greatest economic threats is the effect of air pollution on commercial tree species. As Congressman John Seiberling noted: "An economic resource [is] being jeapordized." Although specific dollar figures have not been developed for either the amount of affected resources or the amount necessary to solve the problem, Chairman Vento indicated that "the cost of not doing anything is reflected in the red spruce damage."

Recommendations of Witnesses

Dr. Mohammed El-Ashry of the World Resources Institute and Dr. Ellis Cowling agreed, along with other witnesses, that further effort is needed to characterize the biological consequences of multiple air pollutants, such as ozone in combination with acidic deposition on trees. More research and monitoring is necessary to fill in some of the gaps in the base of knowledge.

Dr. O. Taylor recommended that research on acid rain be conducted similarly to those that have previously been conducted for ozone.

> What we need to do is just like we did
> with the ozone: go back to experiments
> where we can control the acid.

Along similar lines, Chairman Vento asked that the Park Service work in conjunction with other researchers so that a transfer of information can take place, such as a comparison of susceptible plant species found in the parks with the performance of agricultural crops under similar circumstances.

> we need to make sure that the information
> [being produced] in the lab can be compared
> with what is happening in the field.

Because of the potential to learn from the West German forest experience, Chairman Vento expressed the desirability for an exchange of scientists and information between the United States and Germany.

Dr. Cowling presented a summary of findings and recommendations based on the information and conclusions outlined in his testimony:

[I]t seems prudent that the United States and Canada earnestly continue their historic air quality planning and evaluation procedures.

In doing so, leaders of industry and government. . . should recognize that: one, research is continuing; two, an integrated (multi-pollutant and regional) program for management of air quality would have many advantages over the present single-pollutant and state-by-state or province-by-province methods of planning; three, cooperation, consultation, and statesmanship may produce more economically and scientifically sound management plans than legislatively mandated solutions; and four, the earliest possible date for significant decreases in emissions, except through energy conservation and decreased use of energy and materials, will be in the mid 1990s [because if a decision were reached in 1984 or 1985 to achieve significant additional decreases in air emissions. . . it will take at least five years to develop specific. . . implementation plans and at least another five years to design and build the machinery and control systems that would be necessary].

AIR POLLUTION IMPACTS ON PARK VISIBILITY*

Introduction

Deterioration of visibility in and around units of the national park system is perhaps the most widely spread, observable impact of air pollution on the parks, according to hearings testimony. National Park Service information submitted to the subcommittee noted that "Visibility monitoring has shown that in excess of 90% of the time scenic vistas are affected by man-made pollution at all National Park Service (NPS) monitoring locations within the lower 48 United States."

Photographs based on continuing monitoring of park vistas showed wide variation in what could be seen when comparing photos taken under clean air conditions and those taken when air pollutants were present.

Major Issues Identified

While degradation of visibility is one of the most widesperad and obvious impacts of air pollution on units of the national park system, it is an impact which raised a number of questions during the hearings. These issues cover the legal, technical and the philosophical aspects of air pollution control as they affect the national parks. Discussion often related to the question of whether

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*Prepared by George H. Siehl, Specialist in Natural Resources Policy.

Congress needs to impose more stringent air quality rules, in order to address newly perceived dimensions of air quality deterioration, in parks and other protected areas.

Two other issues included the technical reliability and credibility of monitoring data, and the extent to which units of the national park system are monitored to determine visibility damage.

General Air Pollution Impacts on Park Visibility

The visibility problems associated with air pollution were addressed by lay and scientific witnesses, by industry representatives and by NPS personnel. While many witnesses touched upon the issue of visibility, particular emphasis on the matter was given by Susan Buffone, National Parks and Conservation Association, Douglas Latimer and John Trijonis, private air quality consultants, James Lents, Colorado Department of Health, and Robert White, Western Regional Council Clean Air Committee. William Malm was the principal NPS scientist testifying on visibility, with Superintendents offering extended comments on this problem in their specific parks.

One witness, Douglas Latimer, offered this view of the relationship between visibility deterioration and the other air quality problems in the parks:

> We are discovering that the major air pollution issues of concern regarding national parks and wilderness areas are acid rain and regional haze and that they are interrelated because the same pollutants and sources, by and large, are responsible.

His prepared statement went on to note that "sulfate formed in the atmosphere from sulfur dioxide emissions is the largest single contributor to regional haze in this country."

There are significant regional differences in deterioration of visibility, with the East showing a greater degree of damage than the West. The NPS document on visibility cited a drop during summer in visibility in the East of over 50% since 1948 to a current visual range of less than 25 kilometers.

Visual ranges are considerably greater in the West, as is shown in the figure which follows, ranging as high as 187 kilometers along the Utah-Nevada border. The clearest and best possible visibility range is stated as 391 kilometers.

The Park Service reports that urban visibility has increased in California since 1968, but that visibility in pristine areas in that State decreased between 1959 and 1976. Such trends are indicative of the complexity of air quality issues generally, as was brought out by a number of witnesses.

There was nearly unanimous agreement that additional, expanded monitoring is needed to more fully understand visibility reduction caused by air pollution.

There was considerable disagreement on the question of whether enough is known to start a more extensive control effort. Mr. Lents, for instance, testified that "Congress should mandate a process to develop regional visibility and acid deposition standards." In contrast, Mr. Green proposed formation of a blue-ribbon commission to develop factual information to remove uncertainties "before Congress burdens the consuming public with a tremendous cost for additional pollution control without knowing what benefits, if any, will result."

One other area in which industry representatives strongly disagreed with testimony submitted by others was on the concept of protecting "integral vistas". Mr. White identified these as "areas of land outside, but visible from within, the Class I areas" which were addressed by Environmental Protection Administration (EPA) regulations seeking to have visibility within these areas protected. Class I areas are those National Park and Wilderness areas defined in the Clean Air Act amendment of 1977 in which virtually no increase in air pollutants is allowed. Mandatory Class I areas are wilderness and memorial parks of over 5,000 acres, and national parks of over 6,000 acres which were in existence on the date of enactment of Clean Air Act amendments, plus any other areas which had been redesignated as Class I by that time. Mr. White stated that the Western Regional Council "opposes the integral vista concept" and recommended that Congress should repudiate the concept.

Ms. Buffone of the National Parks and Conservation Association stated in her prepared testimony that the EPA regulations "acknowledge that the visual values of the park do not stop at the parks' boundaries". She later stated, "Mr. Chairman I urge you to encourage and insist that the Department publish an integral vista list." Ms. Buffone elaborated upon integral vistas, a concept stemming from 1980 EPA visibility regulations. The regulations allow Federal land managers to identify views and vistas integral to the parks' purpose and thus serve as a guide to the states in their air pollution control permitting process. The problem, as she explained it, is that the list was published in preliminary form in 1981, but has not yet been finalized. The regulations require that it must be finalized by December 1985, she stated.

Mr. White's prepared statement discussed the integral vista concept at some length, but concluded with the Western Regional Council's opposition to the concept because it would extend Federal jurisdiction far outside the boundaries of class I areas, frustrating state, local and private land use decisions.

One point of consensus was the view that problems associated with visibility could be most appropriately considered on a regional basis, rather than by the State-by-State method established by the Clean Air Act. Dr. James Lents, Director of the Colorado Air Pollution Control Division, stated that several western states have "banded together on a project to develop some common approaches for developing visibility standards". Both business and environmental interests supported such an approach.

There seemed to be agreement among many witnesses that the primary concern with regard to visibility impairment in the national park was the result of regional haze and not specific smoke stack plumes. Ms. Buffone testified on the problem associated with this, notably that the EPA visibility program deals only with the plumes while "the real problem is regional haze". She said EPA had told her it would be "two or three years before there is any program developed to deal with regional haze".

Mr. Green in his testimony in behalf of WEST noted that a significant contributor to haze in the Grand Canyon area was the urban plume from southern California and, in another case from a forest fire some 180 miles distant rather than from the relatively nearby Navajo power plant and its plume.

Ms. Buffone identified two problems for the NPS in protecting air quality in class I areas, one relating to the definitions employed and the other based upon the need for additional baseline data in order to make decisions on possible adverse impacts on park air quality. These points were not contended by other witnesses and, in fact, the need for greater baseline information was expressed by several others.

The appropriate timing for congressional action to ensure better protection of park air quality, drew differing suggestions. Mr. White's prepared statement called for more information before acting. He wrote that, "we have concluded that there does not currently exist a sufficient understanding of visibility impairment attributable to man-made pollution sources to make possible a coherent regulatory program." Adding that "it is essential that Congress provide EPA adequate time" to understand the causes of visibility impairment and the cause and effects perceived by observers.

Interior Chairman Morris Udall agreed that the database needed to be expanded, but he concluded that prompter action is needed in order to assure protection of the parks and their resources:

> "I think it is important that we get the database that we need. It is obvious to me that we don't know where we are going but we know enough that we ought to be alarmed. We ought to be making some judgments. We ought to be on the conservative side on those judgments because we lose some very precious things if we don't do it.

Air Pollution Chemistry and Visibility Impacts

While the chemistry and physics of pollutants in the air is complex, the effective results of these pollutants, usually, for the park visitor, are found in three forms, the distance, clarity, and color fidelity of the view. The kind and amount of pollutants in the air variously affects these three factors. As the NPS paper on visibility points out, how much of a pollutant is present does not necessarily correlate with how much degradation in visibility results. Different sized particles have varying ability to cut down the transmission of light. Sulfates were most often identified during the hearings as a primary cause of visibility degradation because of their effectiveness at scattering light. The NPS visibility paper noted these monitorng results on visibility reduction:

- Sulfates are the single most important contributor to visibility impairment in NPS units except in the northwestern United States, where fine carbon plays a more prominent role.
- In the Colorado Plateau, an area containing Grand Canyon, Bryce Canyon, and Canyonlands National Parks as well as a number of other park units, sulfates are responsible for 40 to 60% of visibility impairment.
- In Shenandoah National Park, sulfates appear to be responsible for over 70% of visibility degradation.
- On the average, soil-related ("crustal") material is responsible for 10-30% of the visibility impairment.
- Typically, 20% of the visibility reduction is associated with other fine mass, which is comprised of organic carbon, elemental carbon, and nitrates.

Dr. John Trijonis in discussing large scale regional haze in the East also identified the sulfates as being a central factor in reducing visibility, because the particles physically block the light and also serve as nuclei upon which water condenses, further reducing visibility.

In discussing the condensation factor of sulfate particles, he explained that at a relative humidity of 70 percent, the attracted water would correspond to about 2.7 times as much of the original volume of sulfate, with the condensed water becoming a significant factor in reducing visibility.

The implementation of a sulfur dioxide control strategy to reduce emissions by 12 million tons per year, or about 60 percent, in the 31-state control region would lead to more than a 50 percent decrease in sulfate particles over the East, Mr. Trijonis testified. If other factors remained unchanged, he said this would lead to dramatic increases in visual range:

> "the average light extinction level would decrease by nearly 30 percent, and the overall visual range would increase from about 12 miles to 17 miles or about a 40 percent increase."

Latimer also addressed the 12-million-ton reduction strategy and suggested even greater benefits in certain areas, writing in his prepared statement:

> Because sulfate accounts for a large fraction of summer haze, such emission controls would improve summer visibility more--up to 60 percent in the East. (p. 3; Latimer statement)

Latimer also described some of the spatial and seasonal variations which characterize visibility degradation in and out of parks, noting that long distance transport of sulfur dioxide and nitrogen oxides could occur over thousands of miles. The regional haze which results may be "particularly thick in the summer". This is more when photochemical reactions are most rapid, he said. This particularly thick occurrence of haze in the summertime would coincide with the period of highest visitation in most units of the national park system.

Monitoring Air Pollution Impacts of Visibility

The visibility monitoring program of the National Park Service and its relationship with other visibility monitoring programs was outlined by the NPS in a pre-hearing paper for the subcommittee as follows:

> Visibility monitoring has evolved from human observer-based measurements to the use of complex, but highly accurate, automated electrooptical instruments. Over the past year a number of federal agencies have operated and maintained visibility monitoring programs as follows:
>
> - The longest historical visibility data record is based on the furtherest distance large natural targets can be seen. The National Weather Service has recorded "observer determined visual range" at airports since 1948.
> - The National Park Service has established 35 long-term visibility monitoring sites at various remote locations throughout the lower 48 states. The NPS monitoring program was initiated in 1978 at fourteen National Park Service units in the Southwest. Shortly thereafter, visibility monitoring sites were added in the northern Great Plains and northern Rocky Mountains, and in Acadia, Shenandoah and Great Smoky Mountains National Parks. Most recently, visibility monitors have been deployed at parks in the Pacific Northwest and in California.
> - The Bureau of Land Management, United States Forest Service, Electric Power Research Institute and other utility industries have operated shorter term visibility monitoring programs.
>
> Most monitoring programs incorporate, at a minimum, a teleradiometer measuring sky-targeted contrast at 550 nanometers (green wavelength), a 35 millimeter camera system, and a size selective fine particulate monitor.

The adequacy of the visibility monitoring program was criticized upon two basic counts. One touched upon how extensive the visibility monitoring network was in relationship to the size of the park system. This matter was addressed in terms of monitoring generally, as well as based upon testimony that air quality monitoring was taking place in 40 of the 334 units of the national park system. There was consensus that more monitoring would be helpful.

The second line of examination was focused upon the reliability of the equipment and the integrity of the data and their use. The NPS felt relatively confident on this matter, and so testified under questioning.

The matter of how widespread monitoring within the parks should be was addressed by Congressman Seiberling and NPS Associate Director Richard Briceland who agreed that more should be done, including monitoring in all Class I areas. Briceland stated that he hoped to "substantially expand" monitoring activities for baseline data, vegetation and visibility studies.

The reliability of the visibility monitoring equipment and evaluation was questioned in the prepared statement of the Western Energy Systems Transmission Associates (WEST). Their critique of the monitoring program noted several problems an interpertation of data collected:

> Several instruments, including the teleradiometer developed by the Park Service, provide only an indirect indication of visibility. The instruments are often touted as providing complete answers, when in reality they provide only indices or partial answers. One of the chief drawbacks of the teleradiometer type of instrument is the subjectivity of its human operator in the interpretation of results, including adjustments for weather, cloud shadows, and the inherent contrast of the target. The cumulative uncertainty of data obtained with any instruments must be fully substantiated before scientific meaning can be placed on the derived results. This has not been done. The Park Service also uses cameras to document and derive visibility indices. While photos could tell us much more about the visibility than teleradiometer type observations, the Park Service uses 135 mm telephoto lenses in their work, which do not represent what the human eye sees. Further, in analyzing the results, one encounters many of the same interpretative problems as with teleradiometer type observations. (p. 4; WEST statement)

Dr. William Malm, the Park Service's leading scientist on visibility aspects of air pollution, when questioned on the reliability of the equipment, described how NPS used and validated the devices, and stated that they were accurate.

Congressman Hansen questioned the reliability of the photographic component of the visibility monitoring program with Superintendent Cook of Great Smoky Mountains National Park. Mr. Hansen observed that the time a photograph is taken may present much different conditions than were present a minute sooner.

Superintendent Cook responded

> "...the information we provided the committee and others with regard to the photograph for the Great Smokies has been done in a very straightforward and a very, very well documented manner so as not to make it make a case one way or the other", with the pictures being taken at the same time everyday. (p. 133; May 21)

Subcommittee Chairman Vento added that these questions had been explored with Subcommittee and Park Service staff and that the photographs should be viewed as having "a certain validity and reliablity."

Dr. Malm noted that there are parameters which are not being monitored as a part of the park visibility program. He noted that nitrates, carbonaceous material, and elemental carbon among as pollutants not now being monitored in the parks.

Dr. Malm, in response to a question by the chairman, later pointed out another unmonitored aspect, stating, "dry deposition monitoring is not currently, to my knowledge, being carried out any place within the western United States."

The present limitations in the number of parks being monitored, 35 of 334, was noted as a shortcoming in the visibility monitoring program by several subcommittee members and Park Service representatives.

Impacts Reported in Specific Parks

Examples of degraded visibility were reported from parks in all regions of the country, with the greatest degree of damage being seen in the eastern units. The NPS visibility paper noted the pandemic nature of the problem, stating:

> Visibility monitoring has shown that in excess of 90% of the time scenic vistas are affected by man-made pollution at all National Park Service (NPS) monitoring locations within the lower 48 United States. Even in remote areas such as Grand Canyon National Park, visitors sometimes cannot see the opposite canyon rim or the canyon depths because of poor visibility. At Yosemite National Park, smoke from fires sometimes obscures the view of the well known massive cliffs domes. In Shenandoah National Park, the "Blue Ridge" often appears an unnatural white, gray, or brown, and in Great Smoky Mountains National Park, the natural haze is usually overwhelmed by man-made haze.

In an exchange with Chairman Vento, Dr. Malm disclosed some of the regional variability which exists on park visibility. These differences include the average visual range of only 10 to 25 kilometers in the East as compared with a western range of 150-200 kilometers. He noted that in California, air quality was improving in urban areas and declining in the pristine areas. He stated that the general trend, where data were available and had been analyzed, has been downward in the pristine areas generally.

The park superintendents provided accounts of the condition of the visual quality of their units. One particularly graphic incident in California was brought out by Sequoia and Kings Canyon Parks Superintendent Evision, who said:

> There was a time--my secretary is the best source of information on the park known to man, been there for 43 years, tells me that in the 1940s and into the 1950s she and her family used to go up to Giant Forest each year on the 4th of July to watch the fireworks all over the Central Valley of California, and clear to the coast, she says. It became a geography lesson for her daughters. But in about the mid-1950s they came to the conclusion it was no longer worth going up there. You just couldn't see far enough to see the display.

Superintendent Cook of Great Smoky Mountains National Park commented:

> of course, one of the big things with regard to the Great Smoky Mountains is visibility, because that marvelous blue haze from which the Smokies got their name is no longer blue, nor is it dominated by natural emissions. It is now, as we can show you, gray, and you cannot see forever.

Mr. Vento later asked for more information on the visibility in the park, and was told by Mr. Cook that research in the Great Smoky Mountain Park shows "there has been at least a 30% deterioration" in visibility over the last 36 years.

The conditions at Mesa Verde National Park in Colorado were explained by Park Superintendent Heyder, as follows:

> There definitely is a problem looking to the south, towards Shiprock into New Mexico. This has been certainly holding its own. I have been at Mesa Verde for six years now. It is about the same.

> They have put on some bag treatments at some of the power plants. These have been on now about six months to a year. It is kind of hard to tell whether they are really effective as yet.
>
> To the west, towards the Abajo Mountains, near Monticello, Utah, there is certainly I would say an increase in yellow haze that is noticeable through the year. Certainly it is more noticeable in the summer months than in the winter.

Representative Lagomarsino asked of Grand Canyon National Park Superintendent Marks, "What are your concerns?" Mr. Marks responded that visual quality was especially important because when people come 3,000 miles to see the view and it wasn't available "we do get complaints." He noted that a review show a deterioration of quality and distance of the view over the past several years.

Superintendent Jacobsen of Shenandoah National Park in Virginia described the importance of the view from his park as a part of the recreational experience of the visitor, and explained how that experience was being curtailed:

> Fifty percent of the time in the spring and summer we are unable to see the Allegheny front range, which is less than 35 miles away. In order for visitors standing on the elevated Skyline Drive to get a geographical context of how the park fits into the rest of the geography, they cannot see it. Fifty percent of the time, they can barely see the Massanutten Range, which is the first mountain range which is only ten miles away. When you can't see ten miles at all, that means that anything that lies between you and ten miles away is very visibly impaired. You cannot see the bends of the Shenandoah River down below. It is very difficult to make out the panoply of the forests and the fields, the towns, the roads, which this elevated viewing platforms, the Skyline Drive, offers.

In response to Representative Vento's inquiry, he responded that "without any question" the benefits for which the park was established has been substantially reduced. Mr. Jacobsen noted that the legislative history for the park talks about the opportunity to view the Shenandoah Valley on the west and the Piedmont on the east. He added:

> I think that for many people here on the eastern seaboard, this is one of the few places where they have an elevated highway 105 miles long which lies as much as 3,000 feet above the valley floor on either side. They come for that view. When they are prevented by other than natural reasons from looking down and seeing the world in miniature, I think they very definitely feel cheated and disappointed. And they do complain to us.

The reports of the superintendents from western parks noting the decline of visibility in and around their units are the most frequent reports of air pollution damage in the region.

Economic Factors

Witnessed expressed concern over the economic consequences of allowing or controlling air pollution in a number of contexts during the two days of the hearings. In terms of visibility, the most frequent connection was made to the possible reduction of visitor numbers because of impaired views within and from the national parks. Such a loss of visitors could have serious economic consequences for businesses and governments near the parks.

The testimony did not provide figures to equate any specific loss of tourism dollars to a given reduction on visitation, but there seemed to be agreement that this relationship exists.

Representative Vento addressed economic consequences in his questioning of Senator Sasser, asking if there were any estimates of dollars which could be lost because of the effects of air pollution on the park in Tennessee and a consequent drop in visitation.

Senator Sasser did not have the information available but noted that tourism was the second largest generator of income in Tennessee, adding:

> So in short, if we allow this park to continue to deteriorate as a result of acid rain, there is going to be very substantial economic loss to this region, and I think a very substantial economic loss to the nation.

Representative Seiberling touched upon the economic consequences of air pollution upon commerical resources noting that many timber resources were threatened. He added that individual homeowners faced the loss of trees in their own yards, an aesthetic as well as an economic loss.

The link between tourism and air quality in the parks was first raised by Senator Sasser in his testimony on Great Smoky Mountains National Park. He stated:

> Acid rain in the Great Smoky Mountains poses economic as well as environmental concerns. The Great Smoky Mountains as I said earlier is the most visited park in the National Park System. Sevier County alone had more than 8000 tourist-related jobs created as a result of visits to the Great Smoky Mountains Park. The problems posed by acid rain are many. The solutions forthcoming so far have been few.

Representative Vento pursued the relationship between visitor satisfaction park air quality in his questioning of Superintendent Marks of Grand Canyon ational Park, again seeking specifics on dollar or visitor reductions. Mr. Marks responded:

> I don't think they have come to the conclusion that they would not come back to Grand Canyon. What they have said, though, is that the air quality is better at the source where they have come from than it is in Grand Canyon.

Mr. Marks also noted that Arizona has tourism and recreation as its second principal revenue source but expressed the likelihood of tourists going elsewhere if the air quality deterioration continues. As this continues, he said "where do we go from here, what is to be done about it?"

The tie between environmental quality and continued visitation to the national parks has been recognized as an important consideration in determining future policy. It would appear that additional data would be useful on specific economic impacts, especially on tourism, given the comments of witnesses on the presumed connection, but the lack of dollar figures.

AIR POLLUTION IMPACTS ON CULTURAL AND MATERIAL RESOURCES IN NATIONAL PARKS*

Introduction

Testimony on the adverse effects of air quality on the cultural and material resources of the national parks indicated that the problem affects a wide range of materials and is occurring throughout the nation. Testimony also highlighted the economic consequences of the degradation of building materials and monuments.

While all of the impacts are upon some material or physical resource, there is a distinction to be drawn between ordinary building materials and the historical and cultural resources such as artifacts and monuments which may be constructed of these same materials. In the case of the cultural resources there is the added irreplaceable element of antiquity or artistic effort associated with the resource. The material resource can be replaced at a cost, but the cultural resource is far more fragile and, perhaps, beyond the reach of dollars or talent to restore, as several witnesses discussed.

Two major issues relating to the impact of air pollution on cultural and material resources were identified in the hearings.

The first is that air pollution is causing damage to these resources, but the exact amount of damage attributable to pollution versus normal weathering is not known, nor is the rate of degradation. Additional monitoring and research were indicated as necessary to overcome these gaps in knowledge.

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* This section prepared by George H. Siehl, Specialist in Natural Resources Policy.

The second is that the economic consequences of air pollution damage, primarily from acid precipitation, it is contended, amount to billions of dollars throughout the United States and impact on both the public and private sectors. These costs can be balanced in part against the costs of controlling air quality by limiting the emission of pollutants, which, while unknown, are also anticipated to be quite high. A related cost is the loss of ancient cultural materials and artifacts and more recent monuments which cannot be repaired or replaced.

The principal non-Federal witness addressing damage to these resources was Richard Stein, representing the American Institute of Architects; Susan Buffone of the National Parks and Conservation Association also referred to cultural resource damage in her statement. Susan Sherwood and Edward McManus of the National Park Service were the principal Federal witnesses discussing this problem.

All of the witnesses testified that air quality damage to cultural resources was a pervasive problem. Among the specific problems related to counteracting damage which has already taken place are the expense of restoration work, the possibility that the artistic merit of the original work will already have been lost, or that the remaining quality might be lessened by protective or restoration work.

Research efforts underway to measure the impact of air pollution on various materials as well as on means of preventing or repairing damage to cultural or material resources were described in the hearing.

READEX FICHE

Impacts on Materials and Structures

Materials as diverse as metals such as copper and bronze, and minerals, such as marble and limestone, as well as paint are all subject to damage from acidic content in the air. Mr. Stein noted that "pollutants can be delivered to these materials not only as acids mixed with precipitation, but also in the form of chemical gases or particulates that combine with oxygen or moisture to form strong acids."

Air pollution may affect the full range of structures, buildings and monuments. Thus, bridges, prehistoric dwellings, and commemorative sculptures may eventually deteriorate due to the actions of normal weathering, but often this is accelerated by destruction imposed by air pollution. Richard G. Stein, American Institute of Architects, described the way in which air pollution damages these cultural resources:

> Stone, metals, paint and other materials suffer different kinds of damage, depending on such factors as the type of material, the means by which acid pollution is delivered to the material, and the force with which the pollution impacts. Marble, limestone, and concrete can be particularly susceptible to acid deposition damage. The acids in precipitation can act on the calcium carbonate in the material to form water-soluble gypsum that erodes and washes away the structure surface.

He noted that dry deposition can be even more destructive, eventually causing the stone to split off pieces. Reinforced concrete is subject to corrosion of the metal, which causes more cracking of the concrete and thus more exposure to weathering. He noted that "the failure of reinforced concrete was the major factor in the 1967 collapse" of a highway bridge between Ohio and West Virginia which killed 46 people.

Mesa Verde Superintendent Robert Heyder explained the possible threat of acid rain to the ancient mortar and stone of the dwellings in his park.

The Geological Survey in experimenting with samples of rock found that a 6 percent acidic solution caused 9 percent of the rock to dissolve overnight. He said, "I think that makes a strong case for acid rain to do damage."

Monitoring Impacts on Cultural and Materials Resources

There were several comments on monitoring and research on the impacts of air pollution on cultural resources, with Susan Sherwood, project director of the Park Service's cultural resources acid rain research program, providing the principal summary. Ms. Sherwood testified:

> To follow up on your original question, which is how much work was or was not being done in national parks, we are doing long-term monitoring at two national parks: Mesa Verde, which you heard about earlier today; and Independence. Our funding provides for an addition of one intensive monitoring site per year. So, we can conceivably over the ten-year acid rain program have eight to ten monitoring resources.

These monitoring programs, according to the information which NPS submitted to the Subcommittee prior to the hearings, are "to establish cause and effect links between specific environmental agents and cultural resource deterioration." They consist of "long-term (5-20 years) in situ monitoring of the resource in question and the environment to which it is exposed."

The Park Service is also engaged in a research program to determine the effects of air pollutants on various materials, although the actual testing is being done at four exposure sites outside of national parks. Ms. Sherwood described the research as follows:

> At this point we have four sites for testing the durability of marble, limestone, seven different construction metals and paint. The paint and the metals work is funded by

> the Environmental Protection Agency. The National Park Service is sponsoring the stone research.

The sites, she explained, allows researchers "to look at the behavior of identical materials under different environmental conditions to try to sort out which of the factors are causing which portion of the damage."

Two additional sites may be added next year, one in the Ohio Valley and a pristine location in Canada, she said. Ms. Sherwood also described a research projett which the Park Service is to begin in the summer of 1985 in which some 12 to 15 replica bronze statues across the country would be examined to determine the effects of air pollution damage.

> These are statues that were cast from effectively the same mold. So, we are not introducing any variables, material or configuration.
>
> . . .
>
> These are widely distributed geographically across the country. We have selected those that are the oldest and that have not received any conservation treatment. We will then go out and look at the current condition and the corrosion to try and get some idea of the cumulative nature of air pollution damage.

Ms. Sherwood and Mr. McManus cited a number of organizations with which the Park Service has cooperated or has plans to cooperate to obtain information on the impacts of air pollution on cultural materials. These include the National Institute for Conservation, the Society for the Preservation of New England Antiquities, The Commonwealth of Massachusetts, the California Air Resources Board, the Electric Power Research Institute, and trade associations such as the Portland Cement Association.

The areas where less is known were noted by Mr. McManus, who said, "I feel that, with regard to monitoring the effects of acid rain and acid deposition within the North Atlantic Region, we have been negligent."

Ms. Sherwood noted that most research in materials deterioration has centered on improving resistance to deterioration, not looking at causes.

Impacts Reported Within the National Park System

Identification of air pollution damage to cultural resources within units of the park system is at different stages at different parks. Robert Heyder, Superintendent of Mesa Verde National Park, said "It is difficult to assess any damage to the ruins themselves." Once the sites are excavated, the ruins become subject to weathering and whatever additional damage may occur from acid rain.

Superintendent Robert Davidson of Gettysburg National Military Park cited specific damage to that park's collection of over 1,300 bronze and stone monuments. He said:

> Our main concern is with the accelerated rates of deterioration. This can be seen in various colored corrosions which appear on our bronze monuments, very disfiguring. They certainly make it difficult to appreciate the artistic value of these works. In addition to the streaking and the disfiguring corrosion, we also have some really dramatic examples of the loss of historic fabric. On some of our softer stone such as limestone and sandstone, the inscriptions actually have been obliterated to the point where they can't be read any longer. Of course, these are worst-case examples.
>
> We have, of course, a large number of granite monuments in the park. They don't seem to be as dramatically affected by the acidity as is the limestone and the marble and bronze. [p. 180-81; May 21]

Edward McNamas, National Park Service metal conservator, also addressed the changing impact of air quality related damage to cultural resources, stating, "My concern is that in the past few years rates of corrosion have been increasing because of the effects of acid rain," although he also noted the absence of "hard data" to substantiate the connection to air quality.

There have been efforts to mitigate some of the damage caused by air pollution in park units. Gettysburg National Military Park Superintendent Davidson described efforts to use washing and/or waxing to protect surfaces from deterioration.

Additional reports on damage to park cultural resources from air pollution are being prepared for stone resources listed on the National Register of Historic Places, according to the information submitted by the National Park Service. The impacts on monuments and outdoor sculpture for 17 States in the Northeast, Mid Atlantic and Midwest will also be assessed. This information will be included in the Assessment prepared by the Interagency Task Force on Acid Precipitation due for completion in 1985.

Economic Factors

Witnesses who addressed the impacts of air pollution on material and cultural resources were able to provide a number of specific dollar figures for the costs of damage or repair of those resources. Estimates of two million dollars to repair the monuments at Gettysburg National Military Park and an overall estimate of two billion dollars a year in material damage from acid deposition are among the figures cited. Other losses are difficult to measure in economic terms, "a part of the national soul and of the national memory," as Mr. Stein described them, and occur with the degradation of cultural resources. As the impact of air pollution damage is studied more closely, new factors are being discovered which raise the estimates of damage even higher.

In her prepared statement, Susan Buffone noted the following costs of repairing cultural resources damaged by air pollution:

> -- Acid rain has caused such damage to the monuments in Gettysburg National Military Park that the National Park Service estimates that it will cost $2 million to repair them.
>
> -- In 1980 NPS architectural conservator Edward McManus was checking the Statue of Liberty for possible damage caused by protestors who had climbed the structure. What he found instead was acid rain damage. As a consequence, the nation is now spending millions to repair this significant structure.
>
> -- James Hoyte, Secretary of Environmental Affairs for the State of Massachusetts believes that our cultural resources are currently suffering damage and loss of detail that will never be fully restored. A recent restoration project on one monument in Boston Commons cost $10,000.

Mr. Stein's prepared statement contained this estimate of nationwide air pollution damage to materials resources in the United States:

> While no precise dollar figures can be placed on the economic consequences of acid deposition, numerous studies have suggested a cost of enormous dimensions. In 1979, the Council on Environmental Quality estimated that materials damage due to acid deposition amounted to $2 billion a year. A European study estimated that a 50 percent reduction in sulfur dioxide could save $1.16 billion a year through avoidance of damage to galvanized steel and other metals. A study conducted in 1970 by R.C. Robbins through Stanford University

> indicated that 15 percent of the gold and platinum used in the United States at that time for electrical contacts went to mitigate corrosion caused by sulfur dioxide. An examination of air pollution damage to materials in the Boston area in 1983 concluded that sulfur dioxide effects on paint could cost as much as $31 million, while a 1972 study on paint damage nationwide put the cost at $540 million.

In response to a question from Chairman Vento, Mr. Stein elaborated on his statement by adding:

> All the figures we have seen suggest that the economic damage is far greater than any of the assessments have indicated so far. Each new area we look into adds another factor beyond any of the figures that have been looked at before. [p. 84; May 20]

Mr. Stein cited the non-economic losses resulting from the damage and loss of unique cultural resources as follows in his prepared statement.

> The dollar cost is relatively insignificant compared to the aesthetic and cultural deprivation resulting from the effects of acid rain on materials. All across the country, thousands of outdoor sculptures and monuments, and thousands of irreplaceable historic structures, all of which are unique human statements, are undergoing slow but sure destruction from acid pollution. And as they become lost, a part of the national soul and of the national memory goes with them.

AIR POLLUTION IMPACTS ON NATIONAL PARKS: PART II

ISSUES ASSOCIATED WITH THE CLEAN AIR ACT*

Introduction

Discussions of the impact of Clean Air Act requirements on protection of air quality in the national parks examined the following questions:

—are current standards required under the Act adequate to protect air quality in the national parks?

—can existing mandated transportation strategies be utilized to generate more significant decreases of vehicle-generated pollutants that adversely affect park resources?

—are permitting procedures for new emission sources required by the Act adequate to ensure that new industrial development will not jeopardize existing air quality in the parks?

—what legal authority does the Secretary of Interior have to ensure his active participation in the permitting process?

—what bilateral emission control initiatives can and should be taken to prevent and decrease incursions of transboundary air pollution from Canada and Mexico that threaten air quality in the parks?

--What steps can and should be taken to prevent and reduce acid precipitation and its impact on park resources?

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*This section was prepared by Maria H. Grimes, Specialist in Environmental Policy.

Standards

The Clean Air Act protects better than standard air quality in the national parks through its Prevention of Significant Deterioration (PSD) provisions (sections 160-169), and Visibility Protection for Class I Areas (Section 169A). These provisions require strict pollution limitations in clean air areas to prevent significant deterioration of quality, and strategies to safeguard visibility values in those regions. More fundamentally, the Act requires compliance with health and welfare protective national ambient air quality standards (NAAQS) (section 109), which must be met through the application of continuous emission control technology that will improve air quality. Industry-specific new source performance standards (NSPS) (section 111) govern the amount of emission reductions which plants of a given industrial category must achieve to attain NAAQS. Pollutants regulated by these standards are sulfur oxides (SOx), particulates, nitrogen oxides (NOx), ozone, carbon monoxide (CO) and lead. Regulations for hydrocarbon control which originally were also required, have been withdrawn by EPA. Current PSD provisions regulate sulfur oxides and particulates only.

Chairman Vento questioned whether existing standards are set at levels stringent enough to protect park resources. Congressman Allan B. Mollohan also questioned the adequacy of Clean Air Act requirements in reducing emissions. He asked Dr. Mohamed El-Ashry, Senior Associate, World Resources Institute, whether nationwide sulfur dioxide emissions from coal-fired power plants had decreased since the Act was passed. Dr. El-Ashry noted that, nationwide, there has been an absolute reduction of SO2 from coal-fired power plants, but not necessarily on a regional basis: regardless of NSPS (to which new installations are subject), it is the location of the plants and their concentration in certain areas—illustrated by new power plants that have come on line in the West in the past 10 years—that affect sensitive areas.

Susan Buffone, Clean Air Program Coordinator, National Parks and Conservation Association (NPCA), asserted that the congressional intent expressed in the Clean Air Act was not being fulfilled: the PSD directives clearly required continued cleanliness of the air in national parks, as well as prevention of visibility impairment, and remedying of existing impairment. Yet, Ms. Buffone said, slow implementation is plaguing the PSD program: EPA did not enforce visibility protection requirements until 1983 in the wake of a law suit brought by the Association. Existing regulations also require visibility monitoring in Class I areas. Yet, for the 158 existing Class I areas, EPA has proposed monitoring stations at only 23 sites.

Dr. Ellis Cowling, plant pathologist and director of the Southern Forest Research Center and Acid Deposition Program at North Carolina State University, Raleigh, N.C., also expressed his concern about the adequacy of current standards for SO2, NOx, CO, particulates and ozone, all controlled under the Clean Air Act. He also cited the need to further decrease emissions of volatile organics, toxics, and to reduce acid precipitation. He particularly noted the time lag which occurs between the publication of new requirements and actual implementation:

> If a decision were reached in 1984 or 1985 to achieve significant additional decreases in air emissions of SO2, NOx or VOC, it will take at least five years to develop specific State, provincial, regional, national, or international implementation plans and at least another five years to design and build the machinery and control systems that would be necessary.

Congressman Mollohan wondered whether the Act's mandatory percentage reduction requirement, an additional SO2 emission reduction requirement for fossil-fuel-fired installations, was considered very strict. Ms. Buffone replied that it was adequate.

Charles Epstein, staff scientist at the Environmental Defense Fund (EDF), also expressed concern that, despite existing standards, the prospects of increasing emissions from new coal-fired power plants and other major emission sources are estimated at one-half million metric tons of SO2 annually.

On the other hand, J. Robert White, chairman of the Western Regional Council Clean Air Committee, cited EPA's 1985 Air Quality and Emissions Trends Report (for 1983) which showed that SO2 ambient air quality levels had improved by 36 percent; ambient levels for particulates by 20 percent; and that SO2 emissions had decreased nationally by 19 percent. Mr. White felt that, in the West, these improvements were due to almost $1.5 billion for installation of constant emission controls on smelters and other nonferrous metals plants.

As a part of the testimony of National Park Service responsibilities under the Clean Air Act, Ms. Grier and Ms. Ross discussed NPS efforts to ensure that standards are enforced in the national park system. Ms. Grier said that NPS has been monitoring air quality and visibility in the parks since 1978. SO2 is monitored in 11 parks, ozone in 19 parks, total suspended particulates in 16 parks, NOx in two parks, hydrogen sulfide in one park, fine particulates for visibility at 28 parks, visibility by means of teleradiometers at 29 parks, and visibility by means of cameras in 35 parks.

Congressman John F. Seiberling asked for clarification of "no significant impairment of air quality" as a basis for implementation of standards in Class I areas. Ms. Ross replied that in the case of new major sources being built near Class I areas, statutory requirements are that such a source "shall not cause an adverse impact on the air quality-related values of the Class I area. For visibility, the standard is significant impairment." Mandatory NAAQS are set at levels protective of health and welfare; the latter "includes basically all the resources that are embodied in the national park system", while "significant impairment" applies to visibility protection. In Ms. Ross' view, the term is similar legally to that applied to new sources and to the "adverse effect" term used in connection with NAAQS. All are intended to protect against adverse or significant impacts. Responding to further questions about the adequacy of the standards, Ms. Ross said that NPS had sent formal comments to EPA regarding SO2 and particulate NAAQS concentration levels to protect native vegetation, suggesting that a more stringent standard may be needed. These comments were based on NPS monitoring and research data which indicated that adverse effects on native vegetation occurred at pollutant concentrations below current NAAQS levels. In terms of visibility, NPS found that concentrations below NAAQS can cause adverse impacts, especially in the western parks. However, EPA's final standard was not at the level NPS had requested.

Chairman Vento questioned further NPS's definition of "adverse impact" in terms of existing national standards. Ms. Ross replied that in NPS's view, since provisions specifically addressing prevention of significant deterioration were added to the Act, consideration should be given to the effects of pollutant concentrations in Class I parks at level below NAAQS, and to the statutory tools provided to cope with these effects. NPS has been attempting to develop criteria for an "adverse impact" definition. It has twice published notices of intended rulemaking in the Federal Register concerning this definition, and has asked for comments.

Standards to Protect Visibility

Special requirements to protect visibility and integral vistas in Class I areas as a component of the Clean Air Act's PSD provisions, and the slowness with which EPA was addressing visibility problems were addressed by several witnesses. Ms. Buffone pointed out that current visibility provisions deal only with impacts from smoke stack plumes; according to EPA estimates, it will take two-three more years before a program is fully developed to cope with regional haze, the real cause of visibility deterioration. This will be 10 years after visibility requirements were included in the Clean Air Act.

The original EPA regulations published in 1980, Ms. Buffone said, required the Federal Land Manager (in the case of national parks, the Secretary of Interior) to prepare a list of significant vistas which are integral to the value of major parks. This list is meant to alert States to the need to preserve certain valuable vistas when deciding on permits to build new major sources of pollution. The Interior Department published a proposed list in January 1981, but has not indicated since whether a final list would be published by the December 1985 deadline.

Dr. James Lents, director, Air Pollution Control Division, Colorado Health Department, explained that Colorado was moving toward a State visibility standard because of perceived inadequacies of current Federal actions. Colorado does not believe, he said, that the national PSD restrictions would also protect visibility; for example, consumption of the current Class I increment for total suspended particulates (TSP) throughout the West would result in another 25-mile loss in the present average visual range, or 80 miles instead of the former 160 miles average visual range. Colorado believes that only regional standards can adequately protect visibility in sensitive western areas. However, EPA has stated that it is only authorized to set national standards under the Clean Air Act. (Similarly, Colorado created a Colorado Category I designation to protect eight additional areas in the State from SO2 impacts, because it felt that the Federally designated Class I areas were inadequate for air quality protection.) Dr. Lents also objected to the current practice of permitting Federal Land Managers to assess air quality related values as a means of protecting Class I visibility goals, a procedure which he called arbitrary and involving "technocrats" rather than policy makers.

Chairman Vento asked NPS staff to comment on EPA's recent efforts to develop a visibility protection program. He particularly mentioned recent proposals by an EPA internal task force on visibility which reportedly included increased research in key areas, but was being opposed by Mr. Charles Elkins, acting chief for air and radiation programs, on the basis of insufficient data. Mr. Bill Malm said that NPS concurs with many of the task force's recommendations, especially since they included remedies for gaps in the NPS monitoring program. Chairman Vento asked whether NPS had commented on the recommendations of the visibility task force. Ms. Grier said she understood that NPS comments on the record at EPA made the same recommendations as the EPA staff's.

Compliance with Standards through Permitting Procedures

The discussion concerning compliance with standards through mandated permitting procedures encompassed two elements: one was the degree of legal authority under which the Secretary of Interior, as the Federal Land Manager, participates in the decision-making process of these procedures; the other was the adequacy of the permitting procedures themselves.

Ms. Grier explained that NPS carries out its responsibilities under the Clean Air Act in tandem with its obligations under the Organic Act to protect park resources, including clean air. As a part of its PSD provisions, the Clean Air Act charges the Federal Land Manager with an "affirmative responsibility" to protect the 48 units of the park system designated Class 1 from adverse impacts of air pollution. The Secretary also participates in reviewing permitting applications for new emission sources in cleaner-than-standard areas to determine whether the proposed source will cause an adverse impact on a given Class I area. This activity is a part of the Act's requirement that EPA and the States consult with the Secretary on measures which affect lands under his jurisdiction, including redesignation of Federal lands and visibility protection in Class I areas.

To carry out its own responsibilities under this program, NPS established an air quality office in 1977. At present, the office consists of 18 professionals; its operating budget for FY 1985 is $3.5 million, with a projected like amount for FY 1986. According to Ms. Grier responsibility of the air quality office includes:

> assessing the conditions of park resources and air quality; identifying and assessing existing air pollution impacts and causes; integrating air resources management into service operations and planning; developing interpretive materials for park use; participating with Federal, State and local agencies in the development of regulatory programs; remedying existing resource impacts; and preventing future impacts to units of the National Park System from manmade air pollution.

Ms. Grier added that the Clean Air Act also requires EPA and the States to consult with the Secretary on implementing regulations affecting lands under the Secretary's jurisdiction in general, and on specific issues such as redesignation of Federal lands, or visibility protection, in particular.

Congressman Sieberling then asked for clarification of Interior's role in implementing PSD provisions, noting that the administrator of Clean Air Act requirements is the EPA. Ms. Ross replied that, while primary responsibility for administering the Act does rest with EPA and the States, the Federal Land Manager is assigned a limited and specified role within the implementation process.

Chairman Vento also sought to clarify the role of Interior in the Act's standard-setting process. In view of Interior's responsibility to preserve and protect resources valued at hundreds of billions of dollars, he felt that the Department should play a more active role in the standard-setting process itself since it appears that, for example, current NAAQS are insufficient in protecting the park system from damage.

Ms. Grier noted that among the responsibilites of a Federal Land Manager is approving or denying a construction permit. Chairman Vento asked whether Ms. Grier, in her capacity as Acting Director of NPS, had ever withheld a permit on the basis of air pollution problems. Ms. Grier replied that such a case would not come to her for action, and Ms. Ross added that the Secretary of Interior has delegated the responsibilities of the Federal Land Manager to the Assistant Secretary for Fish and Wildlife and Parks. Whenever a projected new source near a Class I area is deemed to have likely adverse effects on park resources, Ms. Ross said that the Assistant Secretary must make such a finding and so report to the State. To date, no adverse impacts on park resources have been determined. Some key instances involving the NPS occurred in North Dakota in the case of nine new sources: NPS certified that no adverse impacts from the projected sources were likely, thus allowing the State to issue the permits.

Consideration of a potential ozone pollution problem in Shenandoah National Park occurred when two major new sources of ozone precursors applied for a construction permit. Since the Class I increment had not been exceeded for either SOx or particulates, NPS could not make an adverse impact determination. However, it communicated its serious concern about potential adverse impacts to the State, leaving the final decision up to State authorities.

Chairman Vento expressed his concern about the timeliness of notification of an ongoing permitting process to enable NPS to participate and comment. Ms. Ross explained that under the Clean Air Act and EPA's implementing policy States must notify the Federal Land Manager of any potential new sources to be located within 100 kilometers of a Class I area, or a very large major source beyond that distance. When that process works well, NPS is included in the review process very early to enable it to discuss problems directly with the applicant.

Congressman Vento then inquired about permit applications in Alaska where parks generally are not yet designated Class I; only some 5 percent of hundreds of millions acres of parkland are currently subject to a new source review process. Moreover, NPS witnesses said that only 48 out of 334 park units in the contiguous 48 States are currently subject to a review notification process. NPS reviews permits in other than Class I areas to the extent that it knows about them—partly through its monitoring data—but areas not designated Class I are not subject to a mandatory notification process.

Absent more adequate protection under the Clean Air Act permit notification process, Chairman Vento inquired about legal authority under the Organic Act to protect park resources. Ms. Ross said that under that Act the Interior

Secretary is responsible to conserve unimpaired resources such as wildlife, natural objects, and scenery. However, the existence of the Clean Air Act requirements to provide a certain degree of protection for Class I areas appears to raise some legal questions about the continued effectiveness of existing authorities under the Organic Act to protect other units of the park system from adverse impacts of air pollution. NPS believes that such authority exists. However, Supreme Court decisions pertaining to the Clean Water Act have held that the existence of a comprehensive pollution statute displaces the use of certain traditional, Federal common law remedies such as actions based on claims of nuisance and trespass, which typically are used by the Interior Department to enforce Organic Act provisions. Chairman Vento inquired whether Interior's Solicitor's Office had rendered an opinion on this issue and requested copies of such opinions. Further, he asked that the Solicitor's Office review the issue of a possible conflict of authority under the two Acts and of likely impacts on the Department's authority and responsibility to deal with air pollution problems.

Transportation Related Strategies

PSD provisions in the Clean Air Act currently apply only to SO2 and particulates. To provide more comprehensive protection for park resources, several Members and witnesses cited the need for tightening the Act's motor vehicle emission controls for nitrogen oxides (NOx), a pollutant that is a significant component of acid precipitation. Dr. El-Ashry proposed that EPA and key States formulate stricter, comprehensive transportation and regulatory strategies to reduce NOx emissions from vehicles. Dr. James Lents added that gasoline vehicles, diesel vehicles, and other mobile sources each contribute about 4 percent to ambient air degradation in the parks. He said that Colorado had been concerned

> by what we consider a softening of EPA's position on the control of diesel emissions evidenced by its recent heavy-duty vehicle standards.

He added that reductions of 10 percent or more in NOx emissions and fine particles from vehicles could be achieved in the next 10 years if stricter standards were set.

Senator Max Baucus, another witness at the hearing, also considered current NOx vehicle standards inadequate, saying that they might provide adequate localized, but not transboundary, pollution protection. In this connection, he suggested that Congress consider amending section 126 (interstate pollution) of the Clean Air Act to make it more workable, by requiring emission controls of groups of mobile (and stationary) sources rather than continuing the control of single types of sources only.

Congressman Mollohan asked whether enforcement of current law could result in additional NOx controls, or whether new legislation would be required. Ms Buffone replied that the Clean Air Act now permits development of NOx increments for PSD areas where only SO2 and particulates are controlled at present. Nevertheless, she recommended specific legislation requiring the establishment of a NOx increment system. Congressman Mollohan inquired whether any regulations, proposals or litigation were being developed. Ms. Buffone replied that she knew of none although the National Parks and Conservation Association had discussed the possiblity with EPA.

Another perceived gap in protecting parks from motor vehicle pollutants was the lack of monitoring for nitrates. Mr. Malm of NPS said that, although a monitoring program exists for fine particulates, the NPS does not monitor for nitrates, considered an important pollutant. Similarly, NPS does not monitor for carbon monoxide concentrations, although CO is considered a local air quality problem in several heavily-traveled parks.

Bilateral Emission Control Initiatives

The hearings revealed a growing concern by Members and witnesses alike that air pollution incursions from Canada and Mexico contribute significantly to the deterioration of air quality in the national parks; that they offset improvements attained through domestic control strategies; and that no effective mechanism seems to be available to deal with this problem.

Charles B. Epstein of the Environmental Defense Fund urged that a cooperative arrangement be developed with Mexico whose two large and uncontrolled smelters near the U.S.-Mexico border are likely to contribute substantially to air pollution problems in the western regions. He said that one of these smelters at Cananea, Mexico, is expected to triple its production capacity--and its uncontrolled emission--in the next few years. Absent any planned control strategies for either facility, he said, the combined output of the two sources could amount to one-half million metric tons of SO2 a year, or nearly one-third of U.S. emissions in the region.

Dr. El-Ashry also urged that the U.S. and Mexico negotiate an agreement for mutual emission reductions, to be based on the 1983 U.S.-Mexico environmental protection agreement. Congressman Seiberling wondered whether, absent an agreement with Mexico, emissions from the new Mexican smelter could offset any reductions on the U.S. side. Mr. Epstein estimated that Mexican smelters, when fully operational and operating without emission controls, will add significantly to the SO2 load in the impacted region. While any domestic initiative to weaken controls on new polluting sources and postpone smelter emission control deadlines should be rejected, he said, efforts to persuade Mexico to install SO2 removal equipment should be continued. Mr. Epstein added that negotiations were said to be underway with Mexico about installation of controls on these smelters, but that to date he had not heard of any successful conclusions of these discussions.

In response to a related question by Congressman Mollohan whether NSPS and percentage reduction requirements were adequate, Mr. Epstein replied that his organization's greatest concern was with smelter controls—whether an agreement with Mexico can be reached, and whether additional delays in domestic smelter compliance dates will be granted.

Ms. Buffone agreed that much depended on controls on the Mexican smelters and on enforcement of controls on the Douglas and San Miguel smelters. Douglas Latimer of Systems Applications, Inc. said that any smelter emission reductions in the United States would be almost totally offset by the emission increases from the Mexican smelters.

With regard to Canada, Dr. Cowling called for an acknowledgement of the differences between U.S. and Canadian air pollution laws and regulations. For example, he said, Canadian ozone standards currently are tighter than U.S. standards; on the other hand, because of its larger industrial base, the U.S. has NOx emission limitations while Canada only has them under consideration. Chairman Vento added that the Canadian Federal approach toward the Provinces also is different: the Federal government provides regulatory goals and authorizes the individual Provinces to issue appropriate regulations. The Chairman summed up the discussion by pointing out that the U.S. can only control its own sources and hope that ongoing efforts with Canada and Mexico will yield beneficial results in the form of agreements.

Senator Max Baucus discussed a transboundary U.S.-Canada problem involving the proposed Cabin Creek coal mine across the border from Montana, close to

Glacier National Park. Water and air pollution generated by the proposed mine would be borne south into Montana, while considerable economic benefits would accrue for Canada from the project which would mine high-grade coal for export to Japan and other eastern Asian markets. An existing U.S.-Canada Transboundary Water Treaty applies to water pollution, but there is no similar air quality treaty. Senator Baucus added that the International Joint Commission has become involved in the water pollution problem; if the Commission is successful in resolving that problem, the air pollution problem could perhaps also be resolved.

Chairman Vento and Congressman Seiberling then pointed out the evident need to consider air quality problems on a regional as well as an international basis rather than limiting them to State-wide or single park consideration.

Prevention and Control of Acid Deposition in National Parks

Transboundary pollution incursions and deposition in national parks of acidic compounds originating as precursor pollutants at a considerable distance from their sites of impact were discussed largely in terms of their adverse effects on park resources. From the standpoint of clean air legislation, transboundary pollution was debated mainly in terms of its regulated precursor pollutants since prevention and control af acid precipitation is not now a part of the Clean Air Act.

Senator Jim Sasser testified that the Clean Air Act does not protect the national park system from acid precipitation, the acknowledged major source of damage from air pollution. Rainfall in the Great Smokies National Park was 1.5 times greater than in the rest of the Tennessee Valley, he said, but its acidity is 4.1-4.6 pH, or 20 times more acid than normal rainfall.

Chairman Vento asked whether conflicting legislative mandates might be permitting an excessive influx of air pollutants into the Smokies. Senator Sasser cited reductions attained by the Tennessee Valley Authority (TVA), the major pollution source in the area. He said that TVA spent $1 billion in the past 6 years to decrease SO2 by 56 percent and particulates by 90 percent, or a decrease of SO2 from 2.3 million tons/year to 1 million tons/year, and a decrease of particulates of 100,000 tons. While this reduction was partly required under the Clean Air Act, TVA exceeded the mandatory requirement to offset additional pollution from the relatively high-sulfur Appalachian coals it uses. Acid precipitation, Senator Sasser said, is a world-wide phenomenon resulting from manmade activities. It is already acute in Western Europe and is becoming a problem in non-industrial developing regions as well.

Dr. El-Ashry noted that, absent specific controls in current legislation, potential effects of acid precipitation should be included among siting criteria for new industrial facilities. EPA "should conduct an assessment of the contribution of major power plants to acidic deposition in sensitive mountain areas as a basis for proposing control measures."

Dr. El-Ashry added that enough information is now available to formulate a control strategy for precursor pollutants at major contributing sources, with individual reduction targets to be determined. Existing environmental laws and regulations are now based on the polluter-pays principle: a quota system of emission reductions designed for individual major sources would be in line with this principle. It would be compromised if the additional financial burden were distributed nationwide regardless of the emissions volume contributed by each major source.

Large installations to be included in an additional reduction strategy, Dr. El-Ashry said, should include smelters and large power plant complexes such as Four Corners, and mobile as well as stationary sources of NOx in California to benefit parklands affected by ozone damage.

Richard G. Stein representing the American Institute of Architects (AIA) agreed that the only lasting solution was a reduction of precursor pollutants. AIA's position was that.

> sufficient data has become available to determine the principal chemical culprits and that it is past time for development of a Federal plan of action to reduce acid deposition.

When Chairman Vento asked for recommendations as to possible corrective legislation, Mr. Stein cited AIA's position that the polluting source should correct the problem. AIA is also opposed to any program which substitutes long-distance pollution for local pollution or any strategy that would restore former local pollution levels. In the last 20 years, Mr. Stein said, there has developed a strong pattern of pollution transfer from local to more distant deposition sites by means of tall stacks and changes in combustion methods. The effects of this strategy have been noticeable in the Scandinavian countries Germany and Canada. Dr. Cowling added that some of these countries, are taking additional corrective action. He said that in Germany, which has greater industrial density per square mile and population, the Federal government has recommended a 50 percent SO2 decrease by 1992, in addition to current mandatory emission limitations.

Dr. Cowling urged that industry and government recognize that, in addition to continued research:

> an integrated multi-pollutant and regional program for management of air quality would have many advantages over the present single-pollutant and State-by-State or province-by-province methods of

planning, that cooperation, consultation, and statesmanship may produce more economically and scientifically sound management plans than legislatively mandated solutions, but that the earliest possible date for significant decreases in emissions, except through energy conservation and decreased use of energy and materials, will be in the mid 1990s.

Dr. Lents on behalf of Colorado proposed that the Federal Government establish regional standards for acid deposition which would provide better protection for sensitive areas, and be preferable to the Class I increment process. Mandatory regional acid deposition standards should be applicable to all Class I areas. In addition, States would select two or three other standards for less vulnerable areas, set cooperatively by the States and Federal Land Managers. After a State has adopted standards for the various regions, a process should be established to prohibit other States from violating the selected limits.

In terms of formulating future acid precipitation legislation, J. Robert White, chairman of the Western Regional Council Clean Air Committee, urged Congress to consider regional variations and the need of individual States to be flexible when determining initial control efforts to be taken. Initial controls should be required by both stationary and mobile sources in regions where significant acid precipitation problems exist or damage has occurred. Sources should be permitted to use the most cost-effective means of achieving emission reductions, and future reductions should be implemented in a multi-phase program based on research results. Mr. White further suggested that emission control costs not be spread beyond the source in the form of a national tax, and that emission caps should not be imposed.

Senator Baucus reiterated that Clean Air Act standards may not be adequate to protect natural resources against transboundary air pollution such as acid precipitation. He regretted the one-year delay in initiating a U.S.-Canada control program, emphasizing his conviction that available data and information are now adequate for both countries to proceed.

Lastly, Senator George Mitchell also urged early congressional action in the light of "clear and convincing" evidence of nationwide significant damage resulting from acid deposition.

APPENDIX I

Air Pollutants of Major Concern to Society

Table 1. Air Pollutants of Major Concern to Society.

Chemical and Physical Nature of Pollutants:

1) Sulfur dioxide (SO_2)--A colorless gas produced during combustion of sulfur-containing material (i.e., coal and oil) and during smelting of sulfide metal ores. SO_2 is emitted mainly by large stationary sources such as fossil fueled power plants, metal smelters, and certain other industrial and commercial installations.

2) Nitrogen oxides (NO_x)--Two colorless gases (NO and NO_2) produced in any high temperature processes (i.e., combustion of coal, oil, gasoline, and natural gas). NO_x are emitted by both stationary sources and transportation vehicles.

3) Toxic elements--Lead, cadmium, nickel, fluorine, and other toxic elements released mainly by large metal smelters and by transportation vehicles using leaded gasoline.

4) Volatile organic (VOC)--A wide variety of carbon compounds ranging from such simple molecules as ethylene, gasoline, and cleaning and painting solvents to very complex molecules such as pesticides. VOC are produced by many different, usually small, stationary and mobile sources.

5) Carbon Monoxide (CO)--A colorless and oderless but highly toxic gas produced during incomplete combustion of coal, oil, gas or incineration garbage and other waste products. Carbon monoxide inhibits respiration in humans and other animals. It is of concern to society mostly in urban areas where it accumulates in stagnant air mainly from transportation vehicles.

6) Particulate matter--Particulate matter is a catch-all category of pollutants. The substance of concern range from very coarse "fugitive dust" particles that cause soiling of textiles windows, paints, etc., to very fine aerosol particles that cause atmospheric haze or are drawn into lungs where they induce respiratory disease.

These substance are very diverse, both chemically and physically. The larger particles range from almost pure carbon in the case of soot from oil burners to mineral dusts in the case of manufacturing facilities that produce cement, asbestos, clay, ceramic, textile, and other materials. The fine particles range from smoke to all sorts of sulfate ammonium, organic, metallic, and other fine aerosol particles formed by condensation of gases and other volatile substances in the atmosphere. Some of these particles have very remarkable and complex fine structure that are characteristic of the original sources of the emissions.

7) Ozone (O_3) and other photochemical oxidants--These substances occur only as secondary pollutants. They are produced when NO_x and VOC interact with atmospheric oxygen in the presence of sunlight. Ozone is the most important photochemical oxidant. It is one of the most toxic gas to which plants and human beings are exposed in the environment.

8) Acid deposition--Acidic and acidifying substances produced when SO_2, NO_x, and HCl combine with oxygen and moisture in the air to give aqueous solutions or aerosols of sulfuric, nitric, and hydrochloric acids. Acid deposition occurs when these substances are dissolved in rain, snow, hail, dew, and fog (wet deposition). It also occurs by dry deposition of sulfate, nitrate and chloride aerosol particles and as gaseous SO_2, NO_x, HNO_3, and HCL. The acidic substances in wet and dry deposition may be partially or completely neutralized by alkaline earth elements such as calcium, magnesium, potassium and sodium, or by ammonium ions. Acidification of aquatic and terrestrial ecosystems also occurs when ammonium sulfate aerosol and certain other ammonium compounds or ammonia itself are taken up by plants after deposition into ecosystems.

Source: p. 4; Cowling statement.

Table 2. Major Effects of Air Pollution on Society.

Type of Effect	Nature of Effect	Pollutants Involved
1) Effects on human health due to inhalation of air-borne chemicals	Pulmonary disfunction, respiratory disease, and mental retardation (especially in children)	Ozone Sulfur dioxide Nitrogen oxides Particulate matter Carbon monoxide Toxic elements
2) Effects on human health due to atmospheric deposition or leaching and later ingestion of air-borne or soil-borne chemicals via drinking water, fish, or other food products	Diarrhea and mental retardation in children and poisoning of adults by lead, mercury, copper, cadmium, or other toxic elements	Toxic elements Acid deposition
3) Materials damage	Increased corrosion of metals; accelerated weathering of stone and masonry; soiling of textiles, glass, masonry, and other materials; deterioration of paints, plastics and rubber	Sulfur dioxide Nitrogen oxides Particulate matter Ozone Acid deposition
4) Increased, haziness of the atmosphere	Decreased visibility in urban and rural areas with attendant decreases in airport safety and enjoyment of scenic vistas from aircraft and in parks	Particulate matter Sulfur dioxide Nitrogen oxides Volatile organic compounds Photochemical oxidants
5) Fumigation of crops and forests	Decreased growth and yield of crops and forests	Ozone Sulfur dioxide Nitrogen oxides Toxic elements
6) Acidification of aquatic and terrestrial ecosystems	Death and reproductive failure in fresh-water fish, decreased fertility of soils	Sulfur dioxide Nitrogen oxides Acid deposition
7) Decline of forests	Decreased growth, increase mortality, and predisposition of forest trees to biotic and abiotic stress factors	Ozone (?)[1] Nitrogen oxides (?) Ammonia and ammonium nitrogen (?) Sulfur dioxide (?) Acid deposition (?) Toxic elements (?)
8) Fertilization of crops, forests, and surface waters	Increased productivity of crops; forests, and surface waters	Nitrogen oxides Ammonia and ammonium nitrogen Sulfur dioxide Acid deposition Particular matter

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[1] Question marks indicate major continuing uncertainty about the role of specific pollutants even though the involvement of air pollutants generally is widely assumed.

Source: p. 5; Cowling statement.

APPENDIX II

National Park Service Areas Designated as Class I

NATIONAL PARK SERVICE AREAS DESIGNATED AS CLASS I

	Approx. Acres
*Acadia NP, Maine	37,503
Arches NP, Utah	65,098
**Badlands NM, South Dakota (Wilderness)	64,250
Bandelier NM, New Mexico (Wilderness)	23,267
Big Bend NP, Texas	708,118
Black Canyon of the Gunnison NM, Colorado (Wilderness)	11,180
Bryce Canyon NP, Utah	35,832
Canyonlands NP, Utah	337,570
Capitol Reef NP, Utah	221,896
**Carlsbad Caverns NP, New Mexico	46,435
**Chiricahua NM, Arizona (Wilderness)	9,440
Crater Lake NP, Oregon	160,290
Craters of the Moon NM, Idaho (Wilderness)	43,243
Denali NP, Alaska	1,939,493
*Everglades NP, Florida	1,397,429
**Glacier NP, Montana	1,012,599
**Grand Canyon NP, Arizona	1,176,913
Grand Teton NP, Wyoming	305,504
Great Sand Dunes NM, Colorado (Wilderness)	33,450
Great Smoky Mountains NP, North Carolina, Tennessee	514,757
Guadalupe Mountains NP, Texas	76,292
**Haleakala NP, Hawaii	27,208
Hawaii Volcanoes NP, Hawaii	217,029
Isle Royale NP, Michigan	542,428
**Joshua Tree NM, California (Wilderness)	429,690
*Kings Canyon NP, California	459,994
Lassen Volcanic NP, California	105,800
Lava Beds NM, California (Wilderness)	28,640
Mammoth Cave NP, Kentucky	51,303
Mesa Verde NP, Colorado	51,488
**Mount Rainier NP, Washington	235,239
North Cascades NP, Washington	503,277
**Olympic NP, Washington	892,573
**Petrified Forest NP, Arizona	93,493
*Pinnacles NM, California (Wilderness)	12,952
*Point Reyes NS, California (Wilderness)	25,370
Redwood NP, California	27,792
*Rocky Mountain NP, Colorado	263,133
**Saguaro NM, Arizona (Wilderness)	71,400
*Sequoia NP, California	386,642
Shenandoah NP, Virginia	190,535
Theodore Roosevelt NMP, North Dakota	69,675
Virgin Islands NP, Virgin Islands	12,295
**Voyageurs NP, Minnesota	114,964
Wind Cave NP, South Dakota	28,060
Yellowstone NP, Wyoming	2,219,737
*Yosemite NP, California	759,172
**Zion NP, Utah	142,462

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* 8 parks located in non-attainment counties

** 13 parks located in counties part of which is non-attainment

DR. WAYNE T. WILLIAMS

BLACK APPLE INSTITUTE
757 MICHAEL DR
SONOMA, CA. 95476

17 May,1985

Representative Bruce Vento
Subcommittee on National Parks & Recreation
Committee on Interior & Insular Affairs
U.S. House of Representatives

Dear Honorable Representative Vento:

Enclosed is my latest scientific analysis of the effects of air pollution on the growth of ponderosa pine in and adjacent to Sequoia-Kings Canyon National Parks and Sequoia National Forest which I wish to submit as evidence for your oversight hearings on the impacts of air pollution in the National Parks.

Currently, about 25% of the area of Sequoia-Kings Canyon National Parks receives enough air pollution from the Central Valley to elicit symptoms of smog disease on ponderosa pine, the dominant mid-elevation tree. In all, more than 1,200,000 acres of the ponderosa pine forests in the southern Sierra Nevada are diseased as a result of air pollution.

The smog decline disease in the National Parks has statistically and dramatically worsened since 1974-75, and is in a crisis stage for ecosystem integrity as well as park management. In such scenic and irreplacable areas such as Giant Forest and Beetle Rock, not one ponderosa pine is free of smog damage. The debacle of air pollution effects in the southern California National Forests is swiftly being repeated in the southern Sierra National Parks. The evidence in the enclosed paper indicates that when first and second year needles are affected by the disease, and this is a common condition, then significant wood loss is occurring; the annual rings are thinner and the needles cannot produce photosynthates normally. The evidence presented in this paper also strongly and clearly indicates that an ozone ambient air quality standard of 0.08 parts per million not to be exceeded for 1 hour per year would prevent annual ring loss from this primary air pollutant (refer to Figure 4 in the text).

I respectfully request that your committee re-establish this ozone standard, since it was protective of this resource when in place. The current damage is totally unacceptable.

I would be happy to explain these findings for you in more detail.

Sincerely yours,

Wayne T. Williams

Plant Pathologist

Enc. 16 page manuscript

EFFECTS OF AIR POLLUTION ON ANNUAL RING WIDTH IN A PONDEROSA PINE FOREST

By

Wayne T. Williams, PhD and Jo Anne A. Williams, BA

757 Michael Dr. Sonoma, California 95476

Submitted as evidence in hearings of May 20, 21, 1985
U.S. House of Representatives Committee on Interior and Insular Affairs
Sub Committee on National Parks & Recreation

Abstract

Williams, W.T., and J.A. Williams. The Black Apple Institute, 757 Michael Drive, Sonoma, CA 95476.

EFFECTS OF AIR POLLUTION ON ANNUAL RING GROWTH OF A PONDEROSA PINE FOREST.

More than 1,200,000 acres of the ponderosa pine forests in the southern Sierra Nevada are diseased as a result of air pollution. Approximately 25% of the area of Sequoia-Kings Canyon National Parks receives enough ozone pollution to elicit symptoms of smog disease on ponderosa pine, the dominant mid-elevation tree. In 1983 we re-examined 4 permanent study plots established in 1974-75. Smog symptoms on current needles in 1983 occurred on 23.8% of trees compared to 14.5% in 1975. Second year needles had 60.7% with symptoms compared with 44.2% in 1975. Less than 1/2% of the trees had 6 years of needles and 21% had only 2 years of needle retention. Mortality attributable to air pollution was observed. Comparing trees having symptoms of air pollution injury on first or second year needles with trees not having symptoms on those complements revealed a statistically significant decrease in annual ring growth in diseased trees that amounted to 14% in 1983. The decrease in wood production was related to the amount of ozone measured upwind at source cities in the Central Valley. The dose-response equation (Y = 48.58 - 6.03X) where X = ambient annual mean of hourly highs from ozone over the growing season, and Y = arc sine of % difference in ring growth between the 2 classes of air pollution disease indicates that an ozone-oxidant ambient air quality standard of .08 ppm would be protective to the forest.

Contributed poster session.
Symposium on Effects of Air
Pollutants on Forest Ecosystems
(707) 935-1857

To: The Acid Rain
Foundation
1630 Blackhawk
Hills
St. Paul, MN
55122

Effects of Air Pollution on Annual Ring Width in a Ponderosa Pine Forest

By

Wayne T. Williams and Jo Anne A. Williams

The Black Apple Institute

When forests begin to show the effects of chronic air pollution exposure, an immediate concern is whether the injury induced by the pollutants is having effects on the economic value of the resource. The most easily measured factor having economic value in a forest other than direct mortality, is the growth of the trunk via annual ring increments.

In the Southern Sierra Nevada Mountains of California, more than 1,200,000 acres of the ponderosa pine forests are diseased as a result of air pollution. Approximately 25 percent of the area of Sequoia-Kings Canyon National Parks receives enough ozone pollution to elicit symptoms of smog disease on ponderosa pine, the dominant mid-elevation tree.

In 1983, we re-examined 4 permanent study plots established in 1974-75. In 1983, 93 percent of the ponderosa pines in the plots had symptoms of air pollution injury. In 1975, 79.2 percent were diseased (Table 1). Smog disease symptoms on current needles in 1983 occurred on 23.8 percent of trees compared to 14.5 percent in 1975. Second year needles had 60.7 percent with symptoms compared with 44.2 percent in 1975 (Table 2). Less than 1/2 percent of the trees in 1983 had 6 years of needle retention, and 21 percent had only 2 years of needles. Mortality directly attributable to air pollution was observed.

The relative health of first and second year needles was determined to have significantly declined because of smog disease from 1975 to 1983 (Table 3), and the percentage of annual whorls of needles with symptoms of air pollution had also significantly increased over the 9 year observation period.

Within this context of "visible injury" to needles, the photosynthetic organs responsible for wood accretion, the following experiment was undertaken to determine if annual ring growth in the study plots was associated with ambient ozone pollution and precipitation.

Methods: Increment Borings: In September of 1983, 80 increment cores were harvested from the 4 study plots in the Sequoia National Forest. Plot locations and descriptions are found in Williams, Brady and Willison 1977, Williams 1980 and Williams, 1983. All cores were extracted at breast height on the upper slope-facing side of each ponderosa pine. Annual increments were measured on the same day as harvest to the nearest 0.1 mm. Borings were made on at least 15 trees per plot without regard to the health of the tree. Saplings under 4 inches dbh were ignored. Dendrochronologies were established for the eleven-year period from 1972 to 1983 to determine if ambient air pollution during that period could be having an effect on the timber resource. The eleven year dendrochronology was also compared with annual precipitation. Each plot population was split into those

TABLE 1

PERCENT OF PONDEROSA PINES AFFECTED BY AIR POLLUTION DISEASE IN 4 PLOTS ON THE SEQUOIA NATIONAL FOREST

PLOT	PINE RIDGE (n = 25)	LOGGERS POINT (n = 19)	MILK RANCH PEAK (n = 21)	ESHOM CREEK (n = 34)
1983	88%	89%	95%	100%
1975	88.6%	72%	71.6%	84.6%

SD = 10.2 T = 2.71, df = 3 $p_{.1}$ = 2.353, p .05 = 3.182

TABLE 2

PERCENT OF ANNUAL WHORLS OF NEEDLES WITH SYMPTOMS OF AIR POLLUTION DISEASE [1983 COMPARED TO 1975]

PLOT	ESHOM CREEK		PINE RIDGE		LOGGERS POINT		MILK RANCH PEAK	
	1983----	1975	1983----	1975	1983----	1975	1983----	1975
1st yr. needles	41.2	25.9	8.0	8.2	21.1	9.7	34	14.3
2nd yr. needles	76.5	53.4	52.0	41.4	63.2	27.8	53	54
3rd yr. needles	100	33.3	87.0	56.0	84.2	41.9	62	49
4th yr. needles	100	66.7	100	44.0	90.0	38.2	83.1	22.2

PAIRED T STATISTIC (T) = 4.01 SD = 19.23 df = 11 [1-3 yr needles]

TABLE # 3

INTENSITY OF AIR POLLUTION DISEASE ON PONDEROSA PINE NEEDLES RELATIVE TO AGE OF NEEDLES ON 4 STUDY PLOTS IN SEQUOIA NF

PLOT	ESHOM CREEK		PINE RIDGE		LOGGERS POINT		MILK RANCH PEAK	
	1983	1975	1983	1975	1983	1975	1983	1975
1st yr. needles	2.90*	3.38	3.3	3.61	2.92	3.5	2.66	3.58
2nd yr. needles	2.27	2.5	2.62	2.96	2.53	2.99	2.05	2.38
3rd yr. needles	1.28	1.57	1.96	2.11	2.03	2.22	1.66	1.26
4th yr. needles	0.55	0.31	0.76	1.06	0.79	0.49	0.95	0.50

* '4' = HEALTHY; '3' = HEALTHY, OR WITH SYMPTOMS OF NATURAL AGEING, OR WITH VARIOUS PESTS AND DISEASES - NOT SMOG SYMPTOMS; '2' CHLOROTIC MOTTLE INDUCED BY AIR POLLUTION; '1' + UNIFORM CHLOROSIS CAUSED BY AIR POLLUTION; '0' = DEATH BY SMOG.

trees having air pollution-induced disease symptoms on current and/or one-year old needles; and those trees not having visible symptoms of disease on first and/or second year needles. Of the 80 increment cores, 42 were from trees not having symptoms on the youngest needles. The remaining 38 trees had chlorotic mottle, general chlorosis, or necrosis associated with ozone injury.

Ambient Ozone: The California Air Resources Board, National Park Service, and U.S. Forest Service have collected ozone measurements for the region. Ozone pollution in the ponderosa pine forests of the southern Sierra Nevada comes from the cities in the Central Valley and ozone concentrations in the mountains often reach similar concentrations to those in the source areas (Williams etal 1977). The air pollution patterns are well documented with annual oscillations having peaks during July to September.

An eleven year record of ozone concentrations exists for the major source cities of Fresno, Bakersfield and Visalia. A five year record of ozone levels exists for Whitaker Experimental Forest near the Eshom Creek plot. Monthly means of maximum daily 1-hour readings from 1973 to 1983 are charted in Figure 1. All maximum daily 1-hour readings during July through September were averaged per year. This period includes the growing season for ponderosa pine. The asterisks in Figure 1 indicate the averaged concentrations at or above 8 pphm. These 'means' constituted the ozone concentration data base for comparisons with annual ring growth. This method of using ozone source centers is considered valid because of the known receptor-source relationship between cities generating the smog upwind, and the consequent

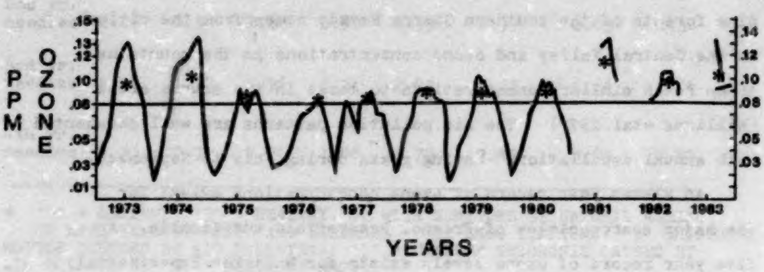

FIGURE 1. ANNUAL AMBIENT OZONE PATTERNS FROM FRESNO, BAKERSFIELD AND VISALIA. ASTERISKS INDICATE MEANS DERIVED FROM MONTHLY HIGH HOURLY MEANS AT OR ABOVE 8 PARTS PER HUNDRED MILLION DURING JULY TO SEPTEMBER, 1973 - 1983.

chlorophyll bleaching reaction of ponderosa pine needles in the forests.

Precipitation: Annual ring growth is known to be directly affected by precipitation. To test the sensitivity of the dendrochronological sample, annual precipitation data from 1931 to 1983 were provided by the National Park Service for three weather stations near the study plots. At Ash Mountain, Giant Forest, and Grant grove, t-tests indicated a high degree of association between weather stations. Because the study plots were at elevations between the weather stations, annual precipitation means from the combined weather stations were used for correlation analysis of precipitation with annual ring growth of the ponderosa pines.

Results: Ozone Monitoring: From 1973 to 1983 at least one of the three test cities in the San Joaquin Valley experienced its peak monthly ozone mean of daily 1-hour maxima during the growing season at or above 8 pphm (Figure 1). Four of the 11 years of ozone data show at least one city having a peak monthly mean of daily 1-hour maxima in excess of 12 pphm. These values occurred most frequently at Bakersfield. Historical ozone measurements (CARB 1976 to 1978) show 1-hour peak values of ozone near the test plot areas that are similar to the peak values recorded in the three test cities. Such concentrations of ozone can elicit symptoms of air pollution disease being discussed in this paper (Miller etal. 1983).

Precipitation and Annual Ring Width: Individual annual growth rings appeared to be positively associated with the amount of annual precipitation (combined plots, df = 42, r = .34 'r' critical $40_{.05}$ = .324). For example, many cores had narrow rings in 1977, reflective of the severe drought, and 1983 growth tended to be more than other years, as did precipitation (Compare Figures 2 & 3). The drought year may have diminished differences in annual ring growth between diseased and non-diseased* trees. The rainy year may have accentuated the differences between diseased and healthy trees, with healthier ponderosa pines more able to produce thicker annual rings than diseased individuals.

Annual Ring Growth and Ozone: In the Split-Plot experiment, air pollution damaged trees had significantly less wood production than the healthier trees (Figure 2). For the eleven year period, between 70 and 80 percent of the time, trees that had smog symptoms on first and/or second year needles in 1983 displayed reduced annual ring widths [paired t test, t = -141.14, df 20 critical $t_{.001}$ = 3.85]. Due to air pollution caused injury since 1979 there has been a steadily increasing loss of annual ring width. In 1983, diseased trees produced 14.6 percent less timber than trees without the disease symptoms on the youngest foliage. Clearly, the air pollution disease is the most probable cause of the observed relationship between reduced ring width and disease symptoms.

Next, the annual ring widths and means of the daily 1-hour maxima ozone concentrations during July to September were compared.

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* Non-diseased in this context means trees without symptoms on the two youngest needle complements.

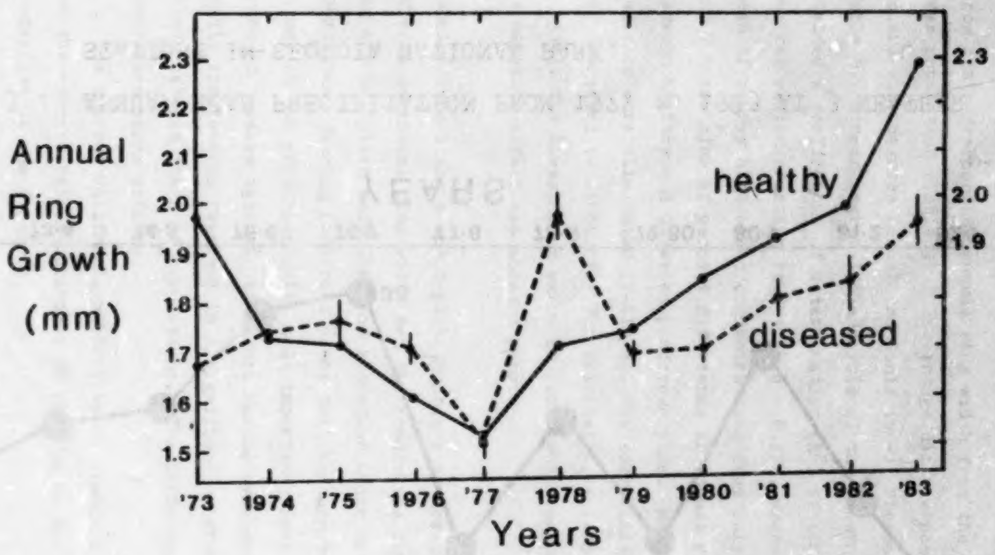

FIGURE 2. ANNUAL RING WIDTHS OF HEALTHY AND DISEASED PONDEROSA PINES IN THE PRESENCE OF AMBIENT OZONE AIR POLLUTION, 1973 - 1983.

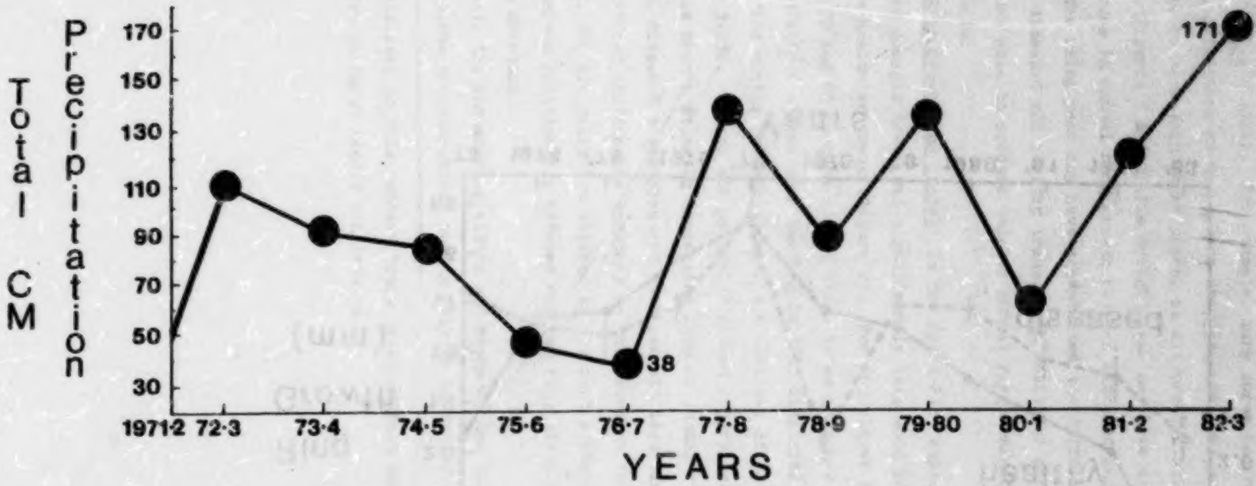

FIGURE 3 . ANNUAL MEAN PRECIPITATION FROM 1971 to 1983 AT 3 WEATHER STATIONS IN SEQUOIA NATIONAL PARK.

Each mean annual ring width from the diseased trees was subtracted from its corresponding annual ring width from the healthier tree population (Table 4). Percentage differences were transformed to arc sine degrees (Sokal and Rohlf 1969). Please refer to Table 4. Linear regression analysis of the growth differences yielded a coefficient of determination (R^2) of .28 [r = .529]. The regression equation is Y = 54.6 - 6.57X, where X = ambient mean of hourly high ozone concentrations from July to September, and Y = arc sine of percent difference in annual ring width between healthy and diseased ponderosa pine. When the bracketed outlyers were eliminated (Table 4), the correlation coefficient 'r' increased to .548[df = 7, r critical$_{.05}$ = .666, r critical$_{.10}$ = .534]. The lowest mean value of ozone which appeared to cause no negative effect was about 8 pphm.

Conclusions: Using a split-plot technique to measure ozone effects on annual ring width met the conditions for proof of cause for air pollution reducing wood accretion under natural forest conditions. Testing ponderosa pines that had symptoms of ozone injury on the physiologically most important first and second years of needles against trees not having symptoms on those needle complements resulted in a significant difference in ring growth between the 2 subpopulations. The differences in ring growth are ozone effects.

The current California ambient ozone standard of 10 pphm and the current Federal standard of 12 pphm do not appear to be protective of the forest.

TABLE 4.

YEAR	MEAN ONE HOUR HIGH OZONE CONCENTRATION JULY TO SEPTEMBER (PPHM)	GROWTH RESPONSE HEALTHIER - DISEASED MM ANNUAL RING WIDTH	ARC SINE DEGREES TRANSFORMATION OF GROWTH RESPONES.
1983	10.1	-14%	-21.97
1982	9.5	-11%	-19.37
1981	11.7	- 6%	-14.18
1980	8.8	- 8%	-16.43
1979	8.8	- 3%	- 9.97
1978	[8.4	-14%	+21.97]
1977	8.3	- 1%	- 5.74
1976	7.5	+ 6%	+14.18
1975	7.5	+ 3%	+ 9.97
1974	10.4	+ 1%	+ 5.74
1973	[9.4	-15%	-22.79]

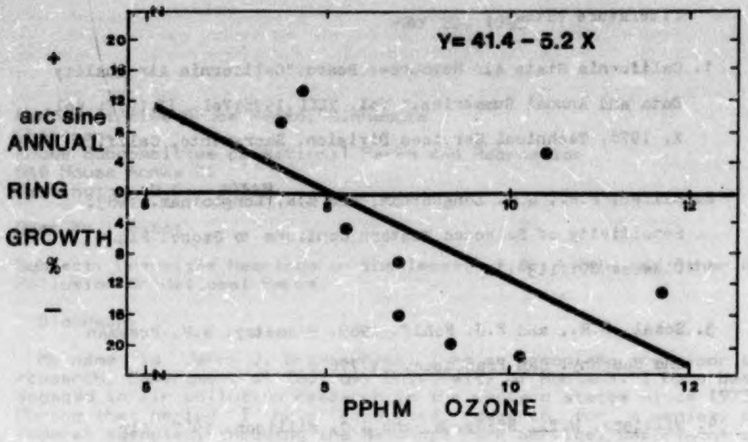

FIGURE 4. RELATIONSHIP BETWEEN MEAN OF HOURLY HIGH OZONE FROM JULY TO SEPTEMBER AND ARC SINE OF PERCENT DIFFERENCE IN ANNUAL RING WIDTH BETWEEN HEALTHY AND DISEASED PONDEROSA PINE.

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MAY 10, 1985

Representative Bruce Vento, Minnesota
Chairman,
House Subcommittee on National Parks and Recreation
818 House Annex #1
Washington, D.C. 20515

Dear Mr. Vento:

Subject: Oversight Hearings on the Impact of Acid Rain and Other Air Pollution on National Parks.

Biography

My name is Jerry J. Bromenshenk. I am an associate professor of research, Department of Zoology, University of Montana. I have been engaged in air pollution research in the western states since 1973. During that period I have conducted research for a variety of federal agencies, incuding the National Park Service, Department of Energy, Bureau of Reclamation, Forest Service, and the Environmental Protection Agency. I was involved in studies in Glacier Park during the early 1970's. Last summer, Mr. Mark Dewart, a UM graduate student under my direction, completed a study of fluoride in the Flathead valley, adjacent to Glacier National Park. Also, I recently spent two months at the Idaho National Engineering Laboratory, working with a research team directed by Dr. Bruce Wiersma, who is conducting global monitoring of air pollutants using sites at Glacier and other parks.

Last summer my co-workers and I completed a study of heavy metal contamination on the Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana. Mr. Gary Ray, another UM graduate student, conducted much of this work and is completing a master's thesis regarding additional aspects of the Grant-Kohrs pollution problems.

In the mid-1970's, I studied the impacts of emissions from coal conversion processes on ecosystems of the midwest. I co-authored reports evaluating the impacts of airborne pollutants on the Boundary Waters Canoe Area, Minnesota, and the potential risk to vegetation resources of the Great Plains with respect to the impacts of sulfur dioxide emissions from synthetic natural gas processes (Argonne laboratories).

Over the last three summers, I have monitored heavy metal pollution in the Puget Sound area. This work has relevance to reported long-range transport of arsenic, which may be affecting at least one of the national parks in western Washington.

In addition, I have consulted numerous investigations of the bioenvironmental impacts of pollutants and have participated in several U.S., European, and Canadian Workshops and Conferences concerning these issues. The most recent were the 1984 Air Pollution Workshop in Banff, Canada, and the Sixth World Congress on Air Quality, 1983, Paris, France.

Testimony

1. Our national parks and recreation areas are being impacted by airborne pollutants. These affect not only aquatic systems, but also the terrestrial systems, including soils.

2. Exposure to airborne pollutants must be considered in the context of multiple exposures to pollutants in other media such as water and soils. For example, on the Grant-Kohrs National Historic Site, the most severely impacted areas are the riverside regions, apparently due to metal contaminated sediments which have been washed down-river from settling ponds and other waste disposal areas, but the ranch has also been subjected to aerial deposition during the 100 year period when the Anaconda smelter was in operation. Recent kills of honey bees in the valley indicate that this problem may be continuing, even though the smelter has closed. Analysis of dead bees indicated heavy metal poisioning, due either to intermittent discharges from current activities such as demolition and flue dust re-processing or to re-entrainment from contaminated soils.

3. Acid rain is just one of the types of air pollution that may affect our parks and recreation areas. In western Washington, toxic metals such as arsenic may be equally or more important. In Glacier, fluoride is the generally assumed to be the major threat, but recent evidence from Dr. Wiersma and others suggest that we should be looking at other chemicals such as aluminum. At Grant-Kohrs, exposures to sulfur and nitrous oxide emissions should have declined with the closing three years ago of the smelter at Anaconda, Montana, but the heavy metal probleme may continue for a long time. Our Puget Sound, Washington, research suggests that a large area of western Washington continues to exhibit high levels of cadmium, although the most likely source of this contamination was eliminated 65 years ago.

4. Pollutant impacts to our national parks and recreation areas affect recreation and aesthetic values. Contamination of streams and lakes is undesirable in terms of our ability to enjoy these resources through activities such as swimming and fishing, and we object to visible evidence of water pollution. There is concern about the impacts of acid rain on our mountain lakes. But, we should not forget other impacts. I worked as a Park Service Naturalist for three summers in Yellowstone Park. Many visitors were concerned

about visible damage affecting the park, such as dead and dying trees. Whereas in Yellowstone the primary causes of tree decline include biotic agents such as blister rust and bark beetle, Glacier Park has a long history of tree decline caused by the interaction of air pollutants and insects, which may still be continuing.

5. Air pollution research has focused heavily on impacts to vegetation such as agricultural crops and forests. But, we have not funded much research on impacts to terrestrial animals. Many investigators consider plants to be more sensitive to pollution damage than animals, but this may not be true. Just as different plants demonstrate different degrees of sensitivity or tolerance to a specific air contaminant, different animals also display different responses. Add to this the fact that responses generally are induced by complex mixtures of pollutants and that we only monitor and attempt to regulate a very few of the thousands of harmful chemicals released annually into air, water, and soils. Simply stated, we don't know what the impacts are to wildlife and other animals. I am hosting a conference on the use of biological organisms and tests to assess environmental problems in Missoula, Montana, in June as part of the regional meetings of the American Association for the Advancement of Science and its affiliated societies. Twenty-eight speakers are scheduled for a two-day period. Only four are discussing vegetation. Many are discussing transfer and magnification of toxic chemicals through food chains. Organisms that appear to be particularly susceptible are many insects, insectivorous mammals and birds, soil micro-organisms, pollinators, predators, and long-lived large mammals, such as big-game.

6. Our efforts at protecting the biological resources of parks and recreation areas have far reaching implications for the very existence of some of the natural aspects of these systems. Many of our parks shelter rare or endangered species and communities. Adjacent to Grant-Kohrs is a rare, prairie plant community. This land has been and may still be subjected to aerial deposits of toxic metals. Similarly, Theodore Roosevelt Park contains remnants of natural prairies which are threatened by sulfur oxides and other air pollutants associated with oil well burn-offs and the region's coal processing.

Current programs do little to fund the research needed to identify the air pollution problem in our parks. Research on complex interactions such as predisposition of trees to insect attack is practically non-existant as in research concerning possible impact to animals. At this time acid rain programs are focusing on lake acidification and forests in the eastern states, in areas that have been so heavily impacted it may be impossible to sort out the variables. Similar activities in the western states, at best will not begin for another year or more. Superfund activities focus on clean-up, not problem identification. EPA's anticipatory research programs have consistently been cut back. Last year, the entire program came close to being terminated.

I have included excerpts from some relevant reports. These have been submitted in their entirety to Dr. James P. Bennett, Ecologist, National Park Service, Air Quality Division.

I wish to thank the committee for their time and effort in conducting this hearing regarding these critical issues.

Sincerely yours,

Jerry J. Bromenshenk

Jerry J. Bromenshenk, Ph.D.
Department of Zoology

KNOWN AIR POLLUTION EFFECTS ON VEGETATION IN NATIONAL PARKS

DOCUMENT A:

May 1985

The Biological Effects Program of the National Park Service's Air Quality Division, begun in 1978, includes the following categories of projects:

Effects Survey: Determines symptoms of air pollution injury on sensitive species and determines geographic extent, severity, and types of effects. May also include installation of biomonitoring plots and lichen surveys.

Sensitivity Screening: Determines what species are sensitive to expected air pollutants using dominant species, bioindicator species, rare and endangered species, and lichens. May be done in the laboratory or the field.

Trace Element Survey: Same as Effects Survey but the focus is on accumulations of toxic trace elements in park food chains.

Ecological Survey: Determines extent, severity and type of effects on plant communities containing large abundances of air pollution sensitive species. Requires installation of permanent plots.

What follows are the results to date of various projects of the types listed above funded by the National Park Service that demonstrate air pollution effects on vegetation in the indicated park units. Although all the following studies demonstrate vegetation effects, they are organized below under two general subheadings, "Effects Studies" and "Biomonitoring," that reflect differences in study approach and purpose.

Effects Studies

The following results come from various projects of the types listed above, collectively called "effects studies", that examine air pollution effects on vegetation as well as monitored concentrations of pollutants. The pollutant concentrations reported below are from NPS monitors physically located in national park units.

Park	Pollutant	Vegetation Effects
Acadia NP	Ozone (Four exceedances of NAAQS* in 1983 & 1984; the maximum hourly average during these years has been 0.14 ppm.)	Of 300 eastern white pine trees studied in 1984, 58% showed some slight ozone injury. A few individuals showed severe ozone injury thorougout the entire canopy. The injury appears to be correlated with decreased width of tree rings, i.e. growth.

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* National Ambient Air Quality Standards (NAAQS):

Ozone: 0.12 ppm/1/hour/1 day

Sulfur Dioxide: 0.50 ppm/3 hour
0.14 ppm/24 hour
0.03 ppm/annual average

Park	Pollutant	Vegetation Effects
Shenandoah NP	Ozone (No exceedances of NAAQS since 1980; however, maximum hourly averages during summers reach as high as 0.12 ppm; monthly means are increasing by .003 ppm.)	Widespread ozone injury in 1982 and 1984 on white pine, tulip poplar, black locust, wild grape, clematis and milkweed. These species were selected for study because they represent diverse parts of the ecosystem and they were known to be ozone sensitive. Injury on the most sensitive species (milkweed) occurred on 90% of the plants observed each year. About 8% of the least sensitive species (black locust) were injured. The injury appears to be correlated with decreased productivity and plant diversity. A survey of trees at elevations above 3000 feet revealed abnormally high mortality of some species.
	Sulfur oxides and heavy metals (Levels of sulfur dioxide are about 20% of the 3 hour NAAQS and 30% of the 24 hour NAAQS.)	Elevated concentrations of sulfur and lead are found in lichens. At some sites, the concentrations are above the normal range for lichens from unpolluted areas. Such concentrations have been associated with lichen decline and food web effects in other studies.
Great Smoky Mountains NP	Ozone (Data collected by TVA show numerous exceedances of NAAQS; however, latest data collected by Tennessee show attainment of NAAQS.)	Between 25-30% of eastern white pine trees show ozone injury. Preliminary evidence indicates that sensitive genotypes may be disappearing and that growth is decreasing.
Saguaro NM	Ozone (No exceedances of NAAQS since 1982; hourly average has reached .110 ppm during the summer.)	Almost all of 225 ponderosa pine trees studied in 1984 showed some ozone injury, with the average foliar injury being almost 12%. Some slight ozone injury was also observed on oak and walnut trees.

Park	Pollutant	Vegetation Effects
Sequoia NP	Ozone (The maximum hourly average during the summer has consistently exceeded or equalled NAAQS since 1981.)	Over one-third (36%) of 540 ponderosa pine trees studied periodically since 1980 show moderate to severe ozone injury. Injury is also common on oak trees. Foliar symptoms, like ozone injury observed in laboratory studies, have been recently observed on giant sequoia seedlings in the park.
Santa Monica Mountains	Ozone and sulfur dioxide (Summer 1984 ozone levels exceeded NAAQS on numerous occasions with the highest hourly average being 0.22 ppm; currently, no sulfur dioxide monitoring is being conducted in the park.)	A study of all types of foliar injury on 7 selected species showed that air pollution injury averaged 40% of all injury. The injury has been related to reduced biomass production which probably destabilizes soil and increases fire fuel loading. In portions of the park, lichens are no longer found ("lichen desert"), indicating long-term exposures to sulfur dioxide.
Indiana Dunes NL	Ozone and sulfur dioxide (Numerous exceedances of ozone NAAQS since 1983; highest ozone hourly average recorded has been 0.16 ppm; sulfur dioxide concentrations are 73%, 64% and 47% of 3 hour, 24 hour, and annual NAAQS.)	Foliar ozone injury is common on 16 species studied in 1984 including white and jack pines. Ozone injury is greater on juveniles than adults. Growth of jack pine juveniles and white pine adults is reduced in areas highest in ozone. A "lichen desert" also exists here indicating long-term exposures to sulfur dioxide.
Cuyahoga Valley NRA, Saratoaga NHP & Acadia NP	Ozone	In a simultaneous fumigation exposure study, ozone injury on quaking aspen genotypes from these parks was significantly less than injury on aspen genotypes from Voyageurs & Isle Royale NPs, which are more remote and probably less polluted, indicating that sensitive genotypes are probably absent, thus diminishing the species gene pool.

The following parks are either exhibiting elevated concentrations of the indicated elements in biosphere organisms or components, or frequent foliar injury from gaseous pollutants. The ecological significance of these effects is unknown but it does indicate that the elements or pollutants are above normally expected levels and that man-made influences are present.

Park	Pollutant	Biosphere Organism or Component
20 Eastern Parks	Ozone	Common milkweed: foliar injury.
Hampton NHS Gettysburg NMP Fredericksburg/ Spotsylvania NMP Petersburg NB	Ozone	Black cherry, white ash, wild grape, sassafras, tulip poplar, dogwood, milkweed, witchhazel, redbud, white pine, Austrian pine: foliar injury.
Isle Royale NP Theodore Roosevelt NP Everglades NP Shenandoah NP Great Smoky Mountains NP	Sulfur	Lichens: abnormally high concentrations.
Shenandoah NP	Lead	Lichens: abnormally high concentrations.
Great Smoky Mountains NP	Lead	Leaf litter: abnormally high concentrations.
Big Thicket NP	Sulfur, heavy metals	Spanish moss: abnormally high concentrations.
Mt Rainier NP	Arsenic	Subalpine fir foliage: abnormally high concentrations.
Great Smoky Mountains NP	Heavy metals	Red spruce: abnormally high concentrations in tree rings.

KNOWN VISIBILITY EFFECTS IN NATIONAL PARK UNITS

DOCUMENT B:

May 1985

Introduction

Visibility monitoring has shown that in excess of 90% of the time scenic vistas are affected by man-made pollution at all National Park Service (NPS) monitoring locations within the lower 48 United States. Even in remote areas such as Grand Canyon National Park, visitors sometimes cannot see the opposite canyon rim or the canyon depths because of poor visibility. At Yosemite National Park, smoke from fires sometimes obscures the view of the well known massive cliffs and domes. In Shenandoah National Park, the "Blue Ridge" often appears an unnatural white, gray, or brown, and in Great Smoky Mountains National Park, the natural haze is usually overwhelmed by man-made haze. A brief synopsis of the NPS visibility program follows.

Visibility Monitoring

Visibility monitoring has evolved from human observer-based measurements to the use of complex, but highly accurate, automated electro-optical instruments. Over the past years a number of federal agencies have operated and maintained visibility monitoring programs as follows:

- The longest historical visibility data record is based on the furthest distance large natural targets can be seen. The National Weather Service has recorded "observer determined visual range" at airports since 1948.
- The National Park Service has established 35 long-term visibility monitoring sites at various remote locations throughout the lower 48 states. The NPS monitoring program was initiated in 1978 at fourteen National Park Service units in the Southwest. Shortly thereafter, visibility monitoring sites were added in the northern Great Plains and northern Rocky Mountains, and in Acadia, Shenandoah and Great Smoky Mountains National Parks. Most recently, visibility monitors have been deployed at parks in the Pacific Northwest and in California.
- The Bureau of Land Management, United States Forest Service, Electric Power Research Institute and other utility industries have operated shorter term visibility monitoring programs.

Most monitoring programs incorporate, at a minimum, a teleradiometer measuring sky-target contrast at 550 nanometers (green wavelength), a 35 millimeter camera system, and a size selective fine particulate monitor.

Visibility Monitoring Results

The National Weather Service data, although not specifically analyzed for visibility trends within national parks, shows long-term trends for geographic regions that include a number of national park units. Results of this analysis show the following:

- Summertime visibility over much of the eastern United States has decreased since 1948 more than fifty percent to a current visual range of less than 25 kilometers (km). In the Great Smoky Mountains, median summer visibility is less than 10 km.
- Although visibility in California's urban and industrial centers has improved since 1967-1968, visibility in California pristine areas has decreased from 1959 to 1976.

It is important to note that in order to simplify the discussion on this complex subject, all the optical data from the visibility monitoring sites has been portrayed in terms of standard visual range, a measure of how far one can see. However, standard visual range is only one of several visibility indices that should be considered in evaluating the degradation of scenic views. Although standard visual range values indicate how far one can see, they do not necessarily indicate how well one can see specific vista features. Other indices would consider color, texture, and proximity of the scene.

Although the NPS monitoring network has not been operated over a sufficient time period to establish long-term trends, it does yield information on seasonal and spatial variation in visibility, as follows:

- Computations using data at all monitoring locations indicate that even at a specific site, there is a wide range in the estimated standard visual range. Appendix I, attached, lists the standard visual ranges at the 10th, 50th, and 90th percentiles (e.g., at the 10th percentile the visibility is equal to or less than the listed value 10% of the time, or one day out of 10).
- The standard visual ranges given in Appendix I also indicate that there is great variability (a) from park to park, and (b) among seasons, with the summer visual air quality generally the worst and the winter the best.
- Atmospheric pollution concentrations are highest during summer months and lowest during winter season.
- The above points are illustrated in the monitoring results for Grand Canyon National Park as shown in Figure 1. The variations in standard visual range are consistent with the higher pollution concentrations in both fine and coarse mass during summer months and lower pollution concentrations during winter months. The higher concentration of particulates is responsible for reduced visual range. Furthermore, the difference in the scenic view between the 90th percentile standard visual range and the 10th percentile is significant. The 10th percentile at Grand Canyon National Park is a visual range of 105 km, a level at which many features in Grand Canyon cannot be seen, the colors of nearby vistas are washed out and some textural features are lost.

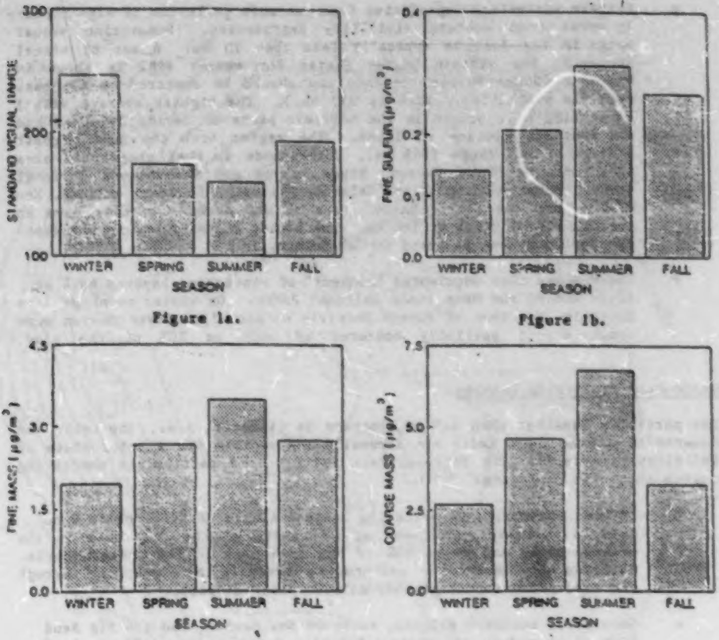


Figure 1a.

Figure 1b.

Figure 1c.

Figure 1d.

Figure 1. Grand Canyon, Arizona seasonal average standard visual range, fine sulfur, and fine and coarse mass concentrations are shown for each season.

- Eastern visibility degradation from man-made pollution is significantly worse than western visibility degradation. Summertime visual range in the East is typically less than 25 km. A map of visual ranges in the western United States for summer 1982 is shown in Figure 2 (Note: numbers on this map should be compared to the best possible visibility, which is 391 km.). The highest average visual range (180 km), occurs in the northern parts of Nevada and Utah and the southern portion of Idaho. The region with the next highest average visual range (165 km), corresponds to that geographic area that contains Grand Canyon, Bryce Canyon and Canyonlands National Parks, commonly known as the Colorado Plateau. Southern Arizona, New Mexico, and the "Front Range" area of the Rocky Mountains have an average visual range of 140 km. The lowest visual range in the western United States is found in California.

- The NPS has also documented "pockets" of wintertime layered haze at Bryce Canyon and Mesa Verde National Parks. On winter mornings, for instance, portions of Navajo Mountain as seen from Bryce Canyon were completely or partially obscured as much as 80% of the time.

Particulate Monitoring Results

Fine particles (smaller than 2.5 micrometers in diameter, i.e., one-tenth the diameter of a fine human hair) are generally responsible for a major share of visibility impairment. The National Park Service fine particulate monitoring program shows the following:

- In most national park units the largest single contributor to fine mass is sulfates which make up 30 to 40% of the fine mass in the western parks and 40 to 60% of the fine mass in the eastern parks. Sulfates are "derivative" pollutants, formed in the atmosphere through the transformation of gaseous sulfur oxide emissions.

- Generally, southern Arizona, southern New Mexico, and the Big Bend area of Texas have the highest fraction (greater than 40%) of the fine mass as sulfates. In the Great Plains, Colorado Plateau area, and southern California, the proportion of sulfates is between 30 and 40%, while in the remainder of the western U.S., where there is sufficient data to report, the sulfates to fine mass ratio is near 20%. Finally, Shenandoah National Park, an eastern park, shows a 56% sulfates to fine mass ratio. For the western United States, the percent of fine mass that is sulfates for the year 1983 is shown in Figure 3.

- In the western United States, the highest sulfur concentrations are found in southern California, Arizona, and New Mexico and in the Big Bend area of Texas. Lowest year-round sulfur concentrations were found in northern California and southern Oregon. These spatial variations in sulfur concentration in the western United States for summer 1983 are shown in Figure 4.

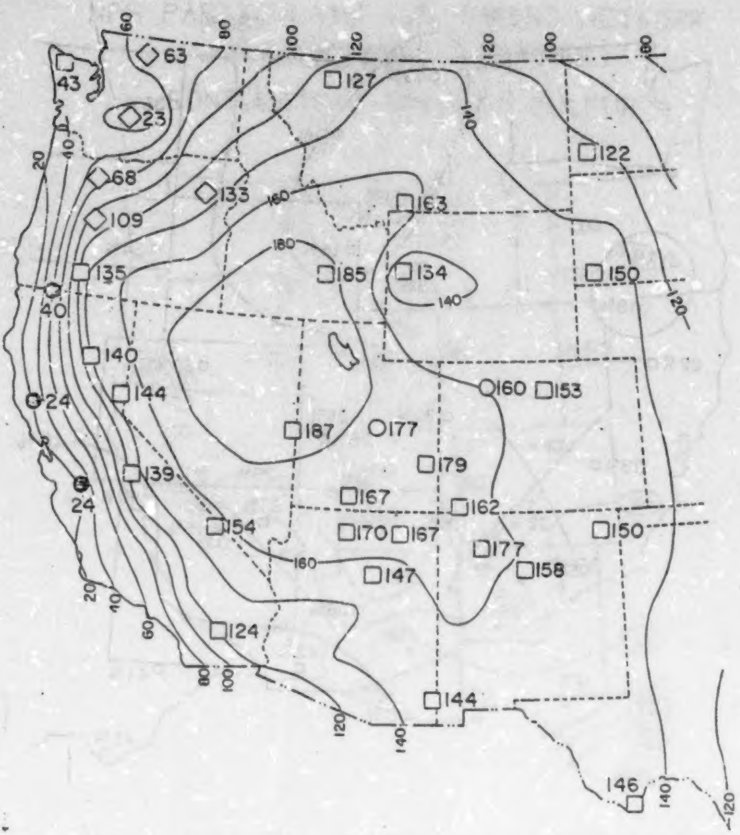
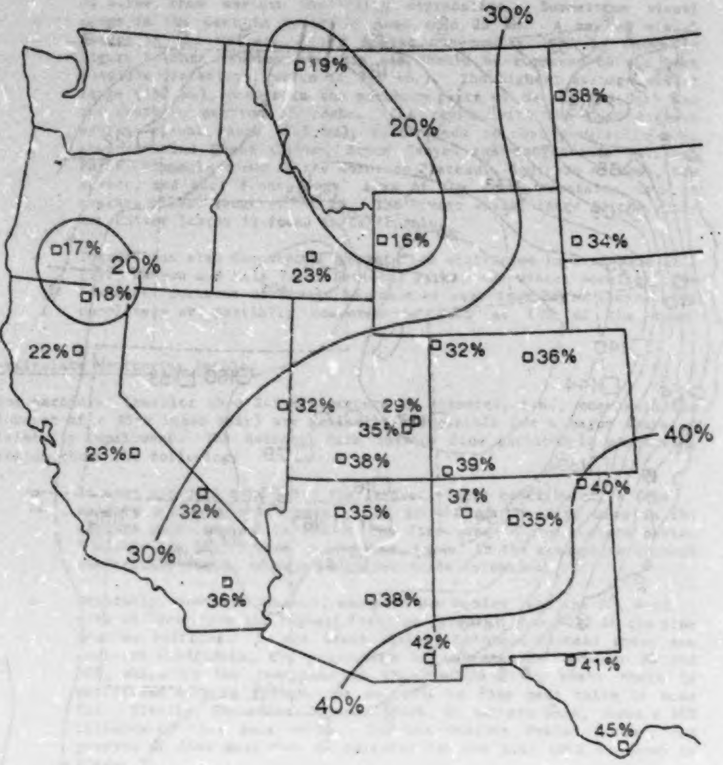

60
80
100
120
120
100
80
63
43
23
127
140
122
20
40
68
133
160
163
109
180
185
134
140
150
120
135
40
140
160
153
24
144
187
177
179
139
167
162
24
154
170
167
150
160
177
147
158
20
40
60
124
80
100
144
120
140
146
140
120

Figure 2. Isopleths of Standard Visual Range over the western United States for Summer, 1982.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37%
32%
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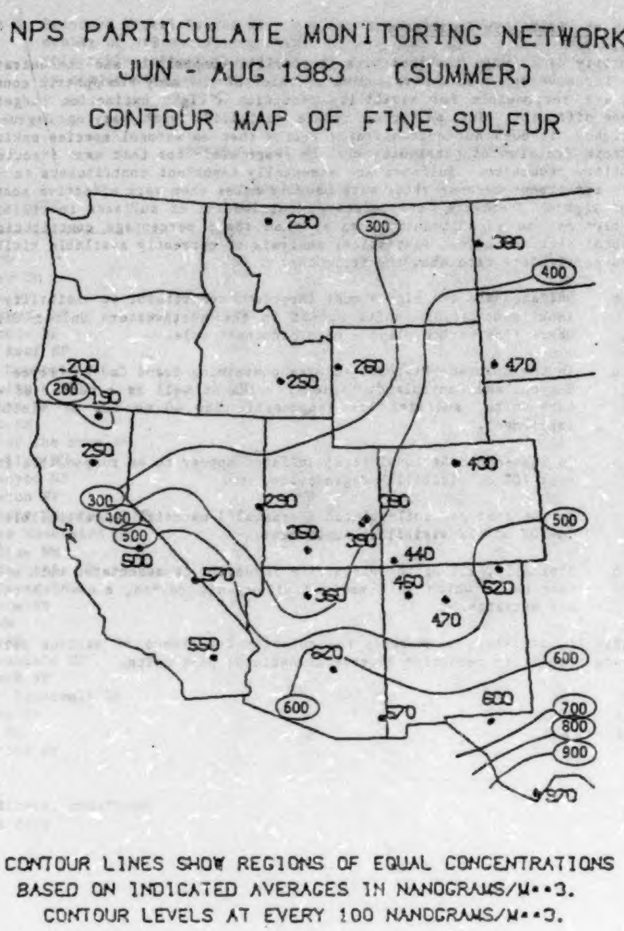
30%
36%
38%
42%
41%
40%
45%

Figure 3. Isopleths of fine sulfate to fine mass ratio in western United States for Summer, 1983.



NPS PARTICULATE MONITORING NETWORK
JUN - AUG 1983 [SUMMER]
CONTOUR MAP OF FINE SULFUR
230
300
380
400
200
200
190
250
260
470
250
430
300
400
500
500
290
390
350
390
500
440
570
460
620
360
470
550
620
600
600
600
570
700
800
900
970
CONTOUR LINES SHOW REGIONS OF EQUAL CONCENTRATIONS
BASED ON INDICATED AVERAGES IN NANOGRAMS/M**3.
CONTOUR LEVELS AT EVERY 100 NANOGRAMS/M**3.

Figure 4. Isopleths of Sulfur Concentrations in western United States for Summer, 1983.

Causes of Visibility Impairment

Visibility data, when combined with particulate composition and concentration, allow for developing an understanding of which of the many atmospheric constituents are responsible for visibility reduction ("light extinction budgets"). Because different size particles reduce visibility with varying degrees of efficiency, it does not automatically follow that an aerosol species making up a certain fraction of total mass will be responsible for that same fraction of visibility reduction. Sulfates are especially important contributors to visibility impairment because their size usually makes them very effective scatterers of light. Therefore, the relative contribution of sulfates to visibility reduction can be significantly greater than their percentage contribution to the total airborne mass. Statistical analysis of currently available visibility and particulate data show the following:

- Sulfates are the single most important contributor to visibility impairment in NPS units except in the northwestern United States, where fine carbon plays a more prominent role.
- In the Colorado Plateau, an area containing Grand Canyon, Bryce Canyon, and Canyonlands National Parks as well as a number of other park units, sulfates are responsible for 40 to 60% of visibility impairment.
- In Shenandoah National Park, sulfates appear to be responsible for over 70% of visibility degradation.
- On the average, soil-related ("crustal") material is responsible for 10-30% of the visibility impairment.
- Typically, 20% of the visibility reduction is associated with other fine mass, which is comprised of organic carbon, elemental carbon, and nitrates.

Appendix II, attached, summarizes the relative importance of various particulates to visibility reduction at several national park units.

APPENDIX I Standard Visual Ranges at the 10th, 50th, and 90th percentiles at a number of NPS monitoring sites. The visual range numbers listed in this table reflect the effects of meteorological conditions as well as atmospheric pollution.

STANDARD VISUAL RANGE (KM): FREQUENCY OF OCCURENCE (%)

SITE	Winter 1982			Summer 1982		
	10%	50%	90%	10%	50%	90%
Acadia NP	40	76	146	40	75	140
Bandelier NM	112	207	379	107	166	257
Big Bend NP	93	186	374	79	139	242
Bryce Canyon NP	163	274	*	113	159	222
Canyonlands NP	80	204	*	125	176	247
Capitol Reef NP	100	212	*	106	160	242
Capulin Mountain NM	155	253	*	89	140	221
Chaco Culture NHP	159	233	342	139	177	226
Chiricahua NM	128	228	*	80	139	240
Colorado NM	122	223	*	-	-	-
Craters of the Moon NM	-	-	-	109	170	265
Death Valley NM	119	214	384	65	110	185
Grand Canyon NP	156	259	*	105	153	223
Grand Teton NP	77	128	213	81	127	198
Great Smoky Mountains NP	2**	57**	176**	5**	24**	47**
Guadalupe Mountains NP	137	175	222	90	129	185
Joshua Tree NM	-	-	-	64	113	200
Lassen Volcanic NP	-	-	-	84	143	242
Lehman Caves NM	-	-	-	120	188	293
Mesa Verde NP	184	241	316	117	162	226
Navajo NM	160	241	363	102	155	221
Olympic NP	-	-	-	36	65	117
Rocky Mountain NP	95	169	299	64	118	216
Shenandoah NP	-	-	-	3	17	78
Theodore Roosevelt NP	59	122	249	72	122	206
Wind Cave NP	-	-	-	70	123	217
Wupatki NM	92	186	376	86	141	232
Yellowstone NP	90	184	376	-	-	-

* Indicates undefined
** TVA data

APPENDIX II.

PARK: % VISIBILITY IMPAIRMENT DUE TO:	Grand Canyon	Bryce Canyon	Canyonlands	Chaco Culture	Theodore Roosevelt	Big Bend	Shenandoah
Sulfate	63%	61%	66%	36%	49%	64%	76%
Other Fine Mass	17%	23%	10%	23%	32%	17%	--
Coarse Mass	20%	16%	24%	41%	19%	19%	--

DOCUMENT C:

AIR POLLUTION EFFECTS ON NATIONAL PARK SERVICE CULTURAL RESOURCES

As yet, field testing has not been in place at National Park Service cultural resources sites long enough to establish the exact cause and effect relationship between specific pollutants and damage to historic and prehistoric building materials.

However, we know that hydrogen ions ($H+$) and sulfur dioxide (SO) speed the degradation of limestone, marble, mortar, and bronze. Marble and limestone dissolution rates derived from controlled experimental exposure testing show that a reduction in the rain H from 5 to 4, doubles the rate at which marble dissolves. We suspect that other pollutants, e.g. nitrogen oxides (NO), airborne particulate matter, and ammonia; and natural agents, e.g. moisture and freeze-thaw cycles, also play a role in the weathering process. What we don't know is how much longer cultural resources would survive in the absence of air pollution as compared to their potential life span in the current environment.

To establish cause and effect links between specific environmental agents and cultural resource deterioration, long-term (5 - 20 year) in situ monitoring of the resource in question and the environment to which it is exposed is needed. Two such monitoring projects have begun recently at Mesa Verde National Park, southwestern Colorado, and Independence National Historical Park, Philadelphia, Pennsylvania. Neither of the projects has been in operation long enough to specifically state the relationship between the pollution level and the deterioration of the resource. Additional monitoring for cultural resource damage is planned for installation at National Park Service sites at a rate of one site each year for the next six years.

In the absence of incontrovertible evidence of air pollution damage to cultural resources derived from on-site monitoring, damage estimates can be calculated by intersecting three sets of information:

1) Damage functions, mathematical expressions derived from scientific experiments, that relate the concentration of pollutants to quantity of material loss.

2) Maps identifying the locations of sensitive cultural resources.

3) Histories of environmental exposure at specific sites, including current deposition, for areas where cultural resources are located.

Estimates of damage to cultural resources are being prepared for stone resources listed on the National Register of Historic Places and for monuments and outdoor sculpture for 17 states in the Northeast, Mid Atlantic and Mid West U.S.. These estimates are planned for inclusion in the 1985 Assessment prepared by the Interagency Task Force on Acid Precipitation and scheduled for release in September 1985.

Attached are summary tables of the sensitive resources in the National Park System.

NATIONAL PARK SERVICE CULTURAL RESOURCES SENSITIVE TO AIR POLLUTION DAMAGE

Monuments

Park Name	# Bronze Statues	# Stone monuments
Custer Battlefield NM	62	
Mount Rushmore NM		1
Saratoga NHP		13
Antietam NB	8	95
National Capitol Parks	42	59
Manassas NB	1	14
Gettysburg NMP	58	379
Petersburg NB		15
Valley Forge NHP	3	37
Andersonville NHS	3	17
Guilford Courthouse NMP		27
Chickamauga & Chattanooga NMP	23	607
Kings Mountain NMP		12
Shiloh NMP		24
Vicksburg NMP	174	463
Lincoln Boyhood NM		13

Buildings	# Brick	# Stone
	327	850

KNOWN AIR POLLUTION EFFECTS ON AQUATIC SYSTEMS IN NATIONAL PARK UNITS

DOCUMENT D:

May 1985

Aquatic Systems:

The Service has 27 areas which are monitored for wet deposition of SO_4, NO_3 and H+ pollutants under the Interagency National Acid Precipitation Assessment Program. We also are conducting watershed research projects under NAPAP in four National Parks (Rocky Mountain NP; Sequoia-Kings Canyon NP; Olympic NP; and Isle Royale NP). These projects focus on changes in water chemistry and soil chemistry associated with acid precipitation. This research was initiated in fiscal year 1982, and the effects of acid deposition on watershed systems and watershed ecosystem processes in these four parks have not yet been established. We do know, however, from this and other research that certain streams and lakes in parks do exhibit elevated levels of acidity following acid rain events (see attached).

Currently the Service is cooperating with a number of agencies and institutions, including the U.S. Geological Survey, to study parks in the Rocky Mountain Region, the southern Appalachians, and the Sierras. The Great Lakes Basin parks are being studied to determine how acids correlate with water quality. Northwestern lakes and streams in Mt. Rainier and North Cascades are being monitored to determine if acid precipitation has affected them.

Our research will establish the long-term effects of airborne pollutants on park watersheds, including lakes, streams, and the associated riparian systems. We also will examine the influence of different management practices in protecting aquatic resources against acidification.

NATIONAL PARK SERVICE

SUMMARY OF EFFECTS OF POLLUTANTS ON AQUATIC SYSTEMS IN PARKS

Park	Pollutant	Effects
27 areas monitored for wet deposition (list attached)	SO_4, NO_3, $H+$	Unknown; NPS areas are receiving acid deposition.
Great Smoky Mountains NP Tennessee-North Carolina	$H+$	Sensitive stream acidity temporarily elevated following acid rain events.
Isle Royale NP, Michigan	$H+$	Temporary increase in acidity of surface waters following acid rain events.
Shenandoah NP, Virginia	$H+$, SO_4	Decreases in alkalinity and available soil nutrients in sensitive streams.
Sequoia NP, California	$H+$	Temporary increases in lake acidity following summer storms.

ENVIRONMENTAL DEFENSE FUND

JUN 25 1985

June 21, 1985

Chairman Bruce F. Vento
2433 Rayburn House Office Building
Independence Ave. between
 South Capitol Street and First St., S.E.
Washington, D.C. 20515

RE: Air Pollution in the Parks

Dear Representative Vento:

It was our honor to have an opportunity for Chuck Epstein to share with your committee the work the Environmental Defense Fund has done to document the threat of acid rain to the high altitude lakes in western parks and wilderness areas. At the close of the hearing, members of the committee asked whether EDF believed that cleaning up the smelters, both in the U.S. and Mexico, is enough to protect the pristine areas of the West. After careful review of the data, including a recent large-scale modeling analysis by EPA, we offer a cautious reply: in the near term (5 - 10 years), SO_2 emission reductions from both U.S. and Mexican smelters will achieve an uncertain but probably adequate measure of protection. In the longer term (10 - 20 years), we believe that additional restraints on pollution growth will be needed. To be effective those restraints need to be implemented on new sources being permitted now.

This assessment is based on two very important caveats. First, both the U.S. and the Mexican smelters must be controlled to meet U.S. emission limits (about 90% SO_2 removal). If Nacozari is not controlled but U.S. smelters are, there will be no net reduction in SO_2 loadings in the Southwest. This will allow current sulfur deposition rates to continue, thereby continuing the threat of acid damage to sensitive lakes.

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Second, this assessment is based on regional loadings and long-range transport of pollutants, and does not consider the increased localized impact of major sources built within relatively short distances (up to about 100 miles) of sensitive mountain terrain. One or more large new sources upwind of a sensitive area can have a dramatic impact on nearby park or wilderness even though regional loadings of acid pollutants are reduced below current levels. These impacts will still need to be carefully evaluated.

This localized effect of a major new source resulted in a precedent-setting permit decision by EPA this month. For the first time, EPA decided that a new technology developed by the Japanese to remove more than 80% of nitrogen oxide (NO_x) emissions is commercially available technology. EPA required Chevron to achieve this level of NO_x control in a permit for Chevron's new oil shale project on Colorado's West Slope, about 45 miles from the Flat Tops Wilderness.

This decision was driven by EDF's evidence that current levels of acid deposition threaten the wilderness lakes, and that acid pollution added by Chevron could tip the lakes over the brink. Thus this decision reflects EPA's conclusion, as well as EDF's, that acid rain represents a serious threat to the West.

The Chevron case also demonstrates the threat posed by NO_x pollution. While the greatest threat from existing sources is sulfur oxide pollution, it is apparent that NO_x will soon exceed SO_2 as the major threat in the West once existing SO_2 sources are brought into compliance with emission limits. Because of the increments for SO_2 in the current Prevention of Significant Deterioration program, new sources of SO_2 (e.g. power plants, synfuels projects and gas sweetening plants) are being required to install highly efficient pollution controls ranging from 85 to 98% removal of SO_2. As a result, new source SO_2 emissions will grow relatively slowly. But the same is not true for NO_x.

Chevron's shale plant is the first source ever required to achieve 80% NO_x control by EPA. This requirement was imposed only because of the close proximity of the large source of NO_x to pristine wilderness lakes. It will be much harder to present evidence linking more distant NO_x sources with direct effects on lakes given the limitations in the modeling science, and the reduced contribution to a specific lake that such a source will have. But collectively, the many new power plants and synfuel projects planned for Utah, Wyoming, Colorado and New Mexico will nonetheless contribute to large increases in NO_x loadings over the next 10 - 20 years if NO_x removal requirements similar to the Chevron permit are not imposed.

To address this problem, EDF believes that an increment for NO_x should be added now to the PSD program. The increment for SO_2 is currently the most effective tool for restraining SO_2 pollution growth because it forces the use of best technology regardless of where the source is located. We need a similar tool to restrain NO_x loadings as well. It needs to be enacted soon because many projects are seeking permits now even though they may not be built for many years. Once issued, the permit is a permanent license to pollute.

In addition to a strategy aimed at restraining NO_x growth, the Park protection provisions of current law need clarification. Most important is the language in the Clean Air Act establishing protections for "air quality related values" (AQRVs) in the Class I Parks and Wilderness. The AQRV concept is defined by statute to include visibility, but otherwise is open to interpretation. The Federal Land Managers have added other impacts such as vegetation damage and acidification of lakes to the list of AQRV's. Some of these impacts are now being observed at current levels of pollution. But apparently nothing can be done to remedy these impacts under current law.

Because Congress specifically mandated that existing visibility impairment be remedied (Sec. 169A) by use of best avialable retrofit technology, but no similar provision applies to other types of park damage, Federal land managers apparently have no recourse against existing pollution that does not cause visibility degradation. Some state agencies and even EPA staff have gone so far as to conclude that existing pollution should not even be considered when assessing the impact of a proposed new source. In other words, if acid rain damage is occurring now at a park or wilderness, this should be ignored when considering whether a new source will cause an "adverse impact" on AQRVs. Thus if a new source can be shown to cause an "adverse impact" by itself, the law will protect the park. But if a source will only add to an adverse impact caused by existing pollution levels, nothing can be done. This interpretation relies on the concept of a "baseline date" in the PSD program which only holds sources accountable for consumption of a PSD increment if they are new after that date. But this concept makes no sense if the goal is to protect a resource that is affected by air pollution. A lake doesn't know if the acid pollution comes from an old source or a new one. It responds to the total amount.

This problem needs to be corrected. The law should make clear that total pollution is relevant to determining adverse impact, and that if harm to a Park or Wilderness is discovered, some procedure should be available to trigger a reduction in pollution levels, and not just stop new sources from getting permits.

To supplement your hearing record, I am also enclosing correspondence from political leaders and editorial opinions from press throughout the West. These call for smelter clean up. You will see the support for action is broadly based throughout the region, and across party lines.

EDF welcomes your leadership in our common goal of preventing in the West the devastation that acid rain has brought to the Northeast, Canada, and northern Europe. We know enough to protect these pristine areas. We only need the will to act.

Sincerely,

Bob Yuhnke

Robert E. Yuhnke
Regional Counsel

cc: Members, Subcommittee on Parks
Interior Committee

Enclosures

United States of America

Congressional Record

PROCEEDINGS AND DEBATES OF THE 99th CONGRESS, FIRST SESSION

Vol. 131 WASHINGTON, TUESDAY, MAY 7, 1985 No. 58

House of Representatives

NATIONAL PARKS AND ACID RAIN

HON. BRUCE F. VENTO

OF MINNESOTA

IN THE HOUSE OF REPRESENTATIVES

Tuesday, May 7, 1985

● Mr. VENTO. Mr. Speaker, while much has been said and written about acid rain, the body of information to date on the subject has tended to focus on the Eastern United States. Recently, the World Resources Institute [WRI], a nonprofit policy research center, published a report describing acidic deposition in the West. The report entitled "The American West's Acid Rain Test" was the result of over 18 months of research on the characteristics relevant to acid deposition in the Western United States.

The risk of damage to various Western ecosystems is only now becoming apparent as research information has become more readily available. Under language I coauthored to the Energy Security Act of 1980, a national monitoring system for acid deposition was established. This research effort, the National Acid Precipitation Assessment Program [NAPAP], is expanding the base of information available on acid deposition. Under this program, the Western United States, for the first time, has come under close review.

Those Western monitoring sites are now beginning to report data needed to analyze the potential risk of acid rain to the West. What this data and analyses are pointing to is that the geophysical characteristics of the Western United States make potential for damage from acid rain different from what is being experienced in the Eastern United States. The WRI report notes that the soil characteristics, precipitation patterns and geological characteristics differ greatly in the West from the East. In certain instances, these characteristics increase the potential acid rain risk; in other instances, the risk is lessened. The WRI report notes that much of the precipitation in the Western United States is in the form of snow. The report noted that studies have revealed that as much as half the acids in snowpacks can be released in the first 10 percent of melt, creating "acid pulses" that can severely harm sensitive aquatic systems. Even within a given area the potential danger can differ. According to the WRI, indications are that acidic deposition occurs at high elevation because the concentrations of acids exceed those of natural alkaline materials. It goes on to note that at lower elevations, deposition is less acidic because relatively more acid is neutralized.

As chairman of the Subcommittee on National Parks and Recreation, I am interested in the acid deposition data being developed in the west because many of the monitoring sites are at or near national park units. Already, collected data has raised some disturbing developments that affect national park units. The WRI report notes that episodes of temporary complete acidification of portions of lakes have been observed in the West. Such was the case at Emerald Lake in Sequoia National Park. The report goes on to note the risk of surface water acidification at 11 national park units located in high mountainous regions. High ozone levels have been documented at Yosemite and Sequoia National Parks. In the Southwest, important archaeological ruins—sandstone formations—at the Mesa Verde National Park are vulnerable to acid damage.

Based on the reports of air quality problems experienced at national park units around the country, the Subcommittee on National Parks and Recreation has scheduled oversight hearings for May 20 and 21, 1985, on air quality in the parks. We will be interested in further exploring some of the points of concern raised by the WRI report, as well as the air quality problems the national parks in other regions are facing.

Our national park units, so often referred to as our "crown jewels," represent a great resource to the people of the United States. Many of us are renewed and refreshed as we admire the wonder and beauty of these resources. Threats to these resources, be it from air and water pollution or development, must be addressed in a responsible manner if we are to pass on to future generations the majestic legacy of our National Park System.●

United States
of America

Congressional Record

PROCEEDINGS AND DEBATES OF THE 99th CONGRESS, FIRST SESSION

Vol. 131 WASHINGTON, WEDNESDAY, MAY 15, 1985 No. 63

House of Representatives

DIRTY AIR THREATENS OUR NATIONAL PARKS

HON. BRUCE F. VENTO

OF MINNESOTA

IN THE HOUSE OF REPRESENTATIVES

Wednesday, May 15, 1985

● Mr. VENTO. Mr. Speaker, our national parks, monuments, and historic sites are among our country's greatest treasures. There is no way to calculate the value of the view from the rim of the Grand Canyon, the peacefulness of an alpine lake in Yellowstone, the inspiration of the Statue of Liberty, or the historic importance of the Gettysburg Battlefield.

The National Park Service is charged with protecting these great treasures, but it appears powerless to stop the destruction which is blowing in with the wind. The recently retired director of the National Park Service, Russell Dickenson, has called air pollution the No. 1 threat to the national parks. As chairman of the Subcommittee on National Parks and Recreation, I agree, and despite the Clean Air Act, the park pollution problem is not improving.

Air pollution is destructive in different ways. Acid rain destroys trees, and accumulates in streams and lakes, upsetting delicate chemical balances which, in turn, can effect fish and wildlife. Dirty air robs visitors of spectacular views. Airborne pollutants fall to the ground, and attack fragile monuments and historic buildings.

Scientists only recently have been taking measure of the damage, but already some scientific data is available, and it is not encouraging. At Acadia National Park in Maine, scientists last year studied 300 eastern white pine trees, and found nearly every one showed damage from excessive levels of ozone. Researchers in Mount Rainer National Park in Washington found high concentrations of arsenic in subalpine fir trees. In Shenandoah National Park in Virginia, scientists are measuring high levels of lead, and noticing widespread damage to trees. Lichens, the fungal alga pioneer plants, are especially sensitive and good indicators of airborne pollutants, and studies are beginning to note the abrupt decline of lichens in national parks from Big Bend in Texas, to Theodore Roosevelt in North Dakota, to the Florida Everglades. In some places, like the Santa Monica National Recreation Area, lichens have disappeared entirely.

Damage to vegetation is just one result of air pollution in the parks. Acid rain is no longer a problem confined to the industrialized Northeast. Recent studies compiled by the World Resources Institute show that western lakes and streams are especially susceptible to acid deposition, because the thinner, lime deficient soils are less capable of neutralizing the airborne acid deposition or rainfall. Scientists have identified many western national parks, including Yosemite, Yellowstone, and Glacier, as being especially sensitive to the effects of acid rain. Temporary pulses of highly acidic water have been measured following rainfall and snowmelt at such parks as Isle Royale in Lake Superior, and at mountain parks such as the Great Smoky Mountains, Shenandoah, and the Rocky Mountains. Such sudden increases in water acidity could seriously hurt or kill aquatic life in park waters.

Air pollution attacks more than plants and animals. The park system protects some 11,000 historic buildings and monuments nationwide, from the Anasazi pueblos of the Southwest to the great monuments of Washington, DC. At Mesa Verde, CO, rangers note the dissolving of sandstone walls built by a long extinct civilization. They have begun studies to determine if air pollution is speeding the process. We have all seen the pictures of the Statue of Liberty surrounded by scaffolding. Workers are repairing a century not just of natural weathering, but of air pollution, which has literally eaten away much of the copper skin. The gravestones on our national battlefields are crumbling, and the statues honoring the soldiers are corroding away. Acid rain can turn marble into soft, powdery talc. That is happening to the marble sculptures of Saint-Gaudens Historical Site in New Hampshire, and its happening to our own Capitol Building. The great scenic parks of America ideally should be places where the hand of man is rarely seen. In the Southwest, a person standing on a high plateau used to be able to see up to 260 miles. Now, air pollution is robbing us of those grand views. Regional haze, and plumes of smoke from everything from wood stoves to coal-fired powerplants are reducing those once grand vistas. At Glen Canyon National Recreation Area near the Four Corners of the Southwest, visibility has declined 25 to 50 percent in the past decade alone. At Arches National Park in Utah, a visitor asked, in the park log book, "is this air safe to breath?" Visibility has declined at other parks where the scenic vistas are among the attractions, such as Great Smokey Mountain and Shenandoah National Parks, as well as the parks of the Southwest Canyon Country, like Bryce Canyon, and the Grand Canyon.

All park visitors can see the results of air pollution on the great scenic park vistas, but most of the effects of air pollution are noticed only by scientists. Researchers have only been studying the problems a short time, and few can point to absolute, provable conclusions which fully satisfy the rigid skepticism of science. But we should note with more than passing interest the early warnings such as the lichens disappearance' in parks from California to Florida, and from Texas to North Dakota. Like the canary in the mine, the lichens indicate great danger ahead. We set aside these national parks and historic sites to be preserved for all time. From the evaluation of the available data, debate, and research, the national park mandate "for all time" may not last until the final air pollution research dissertation is complete.●

Congressional Research Service
The Library of Congress

Washington, D.C. 20540

November 19, 1985

TO : House Committee on Interior and Insular Affairs

FROM : American Law Division

SUBJECT : Comments on Department of the Interior Memorandum of September, 20, 1985 Entitled "Protection of National Park System Units from the Adverse Effects of Air Pollution"

You have asked for CRS review of the above-captioned memorandum regarding the Department of the Interior's authority under existing law to protect air quality in National Park System (NPS) units. The memorandum concludes that "[v]arious laws may be utilized by the Department of the Interior to some extent to protect NPS units from the harmful effects of air pollution. None provides complete protection." Laws discussed in the memorandum consist of the Clean Air Act (especially prevention of significant deterioration and visibility protection), National Park Service Organic Act, constitutional property power, Surface Mining Control and Reclamation Act, and federal and state common law.

Our response to the Interior memorandum takes the form of selected comments rather than exhaustive, point-by-point evaluation. ALD attorneys contributing to this memorandum were Robert Meltz (Clean Air Act), Pamela Baldwin (National Park Service Organic Act and other park management authorities), and George Costello (common law).

Clean Air Act

The Interior memorandum quite appropriately notes the statutory limits in the Clean Air Act's (CAA) program for protecting air quality in the national parks. To recapitulate, limits in the prevention of significant deterioration (PSD) system include the following.

1. It is restricted to only two pollutants: particulates and sulfur dioxide. EPA has ignored the express requirement in CAA section 166 that PSD regulations be promulgated for hydrocarbons, carbon monoxide, ozone, and nitrogen oxides by 1979, and for lead by 1980.

2. No NPS units created after August 7, 1977, can be "mandatory class I". Such units will start out as Class II, and, if they do not meet the criteria in CAA section 164(a)(1)-(2), can be downgraded by states to Class III. NPS units that can be downgraded to Class III include 224 out of the total 337 units. (In fact, however, the redesignation process has rarely been used.)

3. Federal land managers play only an advisory role in redesignation; states may act independently of and inconsistently with the federal recommendation. 1/

4. The PSD system confers no relief from the emissions of existing sources -- i.e., those in existence before the first application for a PSD permit in the area is received from a "major emitting facility." A facility must emit a considerable amount of pollution (100 tons/yr, or 250 tons/yr, depending on the source) before it is deemed "major."

5. The "affirmative responsibility" imposed on the Secretary of the Interior to protect "air-quality related values" is limited to Class I areas. Yet Class II areas, notes the Interior memorandum, "comprise the bulk of NPS units." Moreover, the process through which this responsibility is to be exercised -- part of the review of applications for construction permits, submitted for proposed major emitting facilities seeking to locate in PSD areas -- is a cumbersome,

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1/ CAA § 164(b)(2). See Kerr-McGee Chemical Corp. v. Dep't of the Interior, 709 F.2d 597 (9th Cir. 1983).

highly complex one and is unlikely to be invoked often. A state governor may grant variances from maximum allowable increases of SO2 concentrations, despite the opposition of the Secretary, if the President finds the variance to be in the national interest.

6. The preconstruction review process noted in the preceding paragraph does not even apply if the proposed source's site is not within a PSD area, even if the NPS unit it might adversely affect is within a PSD area. 2/
7. The visibility protection scheme in the CAA is limited to mandatory class I areas (48 out of the total 337 units in the NPS), and the Secretary of the Interior is given solely an advisory function.

In sum, the PSD tools conferred by the CAA for protection of NPS air quality are confined to only certain NPS units, to certain pollutants, and to certain emission sources proposed for certain locations.

Even where the Secretary of the Interior's PSD authorities do come into play, the Act does not specify what, if any, enforcement tools the Secretary possesses. For example, could the Secretary sue to invalidate a state permit for construction of a major emitting facility, granted on the basis of a questionable determination by the state that the proposed source will not cause concentrations exceeding the maximum allowable increases? The Act is silent on such questions, providing an explicit enforcement role only for EPA, the states, and citizens (per the citizen suit provision).

It is an interesting question, apparently as yet undecided, whether the Department of the Interior could use the citizen-suit provision

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2/ Alabama Power Co. v. Costle, 636 F.2d 323, 368 (D.C. Cir. 1979).

in the CAA[3] as authority to enforce the Act's PSD requirements, or indeed to enforce any emission limitations imposed on sources under state implementation plans. A literal reading of the provision does suggest its availability — any "person" may bring a citizen suit, and the Department is included within the CAA's definition of "person."[4] Yet a court could well interpret the key enforcement section of the CAA,[5] which speaks of enforcement only by EPA, as reflecting a congressional intent that EPA be the sole voice of the federal government in matters of CAA enforcement.

Where the threat to national-park air quality stems from pollution sources that are (a) numerous, and (b) out-of-state, the CAA provides no effective mechanism for forcing abatement of emissions from such sources. Section 110(a)(2)(E) does require state plans to --

> prohibit any stationary source within the State from emitting any air pollutant in amounts which will (I) prevent attainment or maintenance by any other State of any ... national ... ambient air quality standard, or (II) interfere with [required PSD measures in the downwind State's implementation plan].

However, the language of this provision, with its focus on individual sources, suggests the difficulty of invoking it to deal with regionwide pollution sources. The principal interstate-pollution provision in the CAA, section 126, is also geared to threats from individual out-of-state sources, a fact attested to by the failure to date of efforts to use section 126 for abatement of regional emissions causing acid rain. In any event, section 126 can be invoked only by states and their political subdivisions, not federal agencies, and only for ensuring maintenance of ambient standards, not PSD increments.

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[3] CAA § 304.

[4] CAA § 302(e).

[5] CAA § 113.

There is, finally, an inherent tension in the institutional arrangement created by the CAA. In the realm of air quality, the federal agency specially charged with protecting the national parks (Interior) has, for the most part, only a consultative role. The federal agency with all the enforcement authority (EPA) has a broad spectrum of air-quality concerns, of which national-park air quality is but one. States, too, have their own priorities and economic needs, with which national-park air quality must often compete. Indeed, which PSD areas should be mandatory class I, whether states should have sole redesignation authority, etc., were issues closely watched by states during enactment of the 1977 CAA amendments.

National Park Service Organic Act and Other Park Management Authorities

Congress created the National Park Service in 1916 to promote and regulate the parks "by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."[6]

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[6] Act of August 25, 1916, ch. 408, 39 Stat. 535, as amended; 16 U.S.C. § 1 et seq.

The General Authorities Act of 1970[7] articulated some of the values for which units were added to the NPS, defined the system, and clarified certain park management authorities. As will be discussed further in the part of this memorandum on common law actions, it is a well-established principle that the United States may bring suit to protect its property, in much the same way as any other property owner can. This authority seems to have been implicit in the park laws since the purposes of parks were set out in 1916. In 1978, Congress amended the 1970 Act by elaborating further on the management of the NPS in language that expressly mentioned protecting System lands:

> Congress further reaffirms, declares, and directs that the promotion and regulation of the various areas of the National Park System, as defined in section 2 of this Act, shall be consistent with and founded in the purpose established by the first section of the Act of August 25, 1916, to the common benefit of all the people of the United States. The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress.

The intent and necessity for this language has generated controversy. The language was part of legislation that was primarily designed to provide greater protection to the Redwood National Park in California. That park had been established in 1968,[8] but logging activities on lands outside the park but within the same watershed were threatening the trees within the park.

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[7] Pub. Law 91-383, 84 Stat. 825.

The 1968 legislation establishing the park had authorized the Secretary to acquire interests in lands by donation, or to "enter into contracts and cooperative agreements with owners of land on the periphery of the park and on watersheds tributary to streams within the park designed to assure that the consequences of forestry management, timbering, land use, and soil conservation practices conducted thereon, or of the lack of such practices, will not adversely affect the timber, soil, and streams within the park as aforesaid."[9] The new park was to be managed in accordance with the 1916 legislation. However, these measures did not prove adequate to protect the redwoods from the erosion and sedimentation that resulted from timbering on lands within the watershed of the park, the Secretary of the Interior did not undertake any other actions, and hence Congress considered various means to secure greater protection.

H.R. 3813 was introduced on February 22, 1977. The bill as reported with amendment by the House Committee on Interior and Insular Affairs reflected the proposed draft submitted by the administration that strengthened the authority of the Secretary in several significant respects. In addition to including additonal acreage within the Redwood National Park, the bill also expanded the authority of the Secretary to enter into contracts and cooperative agreements with landowners and other entities outside the park. Section 1(a)(6) authorized the Secretary to review state regulatory provisions applicable to zones critical to protection of the Park and, if they were insufficient, directly regulate the use of the lands: "the Secretary is authorized to promulgate and enforce reasonable regulations of and restrictions on harvesting of timber and land rehabilitation and management practices within such zones, necessary to provide continuing protection to the lands and other resources within the park . . . ."

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[8] Pub. Law 90-545, 82 Stat. 931.

[9] *Id.* § 3(e).

Furthermore: "The Secretary is further directed to request the Attorney General of the United States to initiate an action for injunctive relief to prohibit any violation or anticipated violation of regulations adopted hereunder or to otherwise require the rehabilitation of privately owned lands or to require other land use practices necessary for the protection of the interests of the United States through action of law. Such an action will lie upon a showing of present or likely damage to established park resources without regard to any other provision of law or standard of conduct."

Section 1(b) contained the language amending the 1970 Act, regarding protection of the parks.

In sum, the bill contained three devices by which activities on private lands outside the park boundaries might be controlled: zones within which the Secretary could regulate; authority for suits to enforce any such regulations or "to otherwise require the rehabilitation of privately owned lands" or to "require other land use practices necessary for the protection of the interests of the United States"; and authority (in the new language amending the 1970 Act) for actions to "protect" parks.

The transboundary effects of the regulatory zones and judicial actions to enforce such regulations are express and clear. The transboundary effects of authorizing suits to abate or control land use practices on private land even aside from the existence of an express federal regulatory program also is expressly stated, but the underlying reasoning in support of the provisions would certainly be of interest as the express stating of authority for such suits was definitely noteworthy.

The intended transboundary applicability of the 1978 amendment of the 1970 Act is not clear on its face. The language could have been intended only to guide actions of the Secretary within parks -- perhaps to emphasize that activities to "promote" the parks under the 1916 Act must also always be protective of park values and purposes. It could also possibly apply to all actions of the Secretary in his capacity as the administrator responsible for management of the NPS, and in his other capacities relating to federal lands (e.g., as administrator of the federal mineral-leasing program). It could also refer to actions of the Secretary and of all federal entities. It could also refer to protective actions of the Secretary to be taken even as to activities on nonfederal lands that threatened NPS units.

The House committee report focused primarily on the new authority to regulate private lands within the critical zones, and indicated that these provisions had been approved by both the Solicitor's Office at the Department of the Interior and the Department of Justice.[10] This legal analysis is not available to us at this time. The report further notes that "a similar approach has previously been adopted by the Congress with regard to fires on areas surrounding National Forest lands; with regard to mining in various National Park Service areas; and, with regard to surface mining activities on certain private lands. "It is with this background that the Committee adopted the regulatory provisions in H.R. 3813."[11/]

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[10] H.R. Report 581, 95th Cong., 1st Sess., 25-26 (1977).

The regulatory provisions were those submitted by the Administration. In its report on the proposal, the Department of the Interior related the provisions authorizing the Secretary to request the Attorney General to seek injunctive relief only to violations of the Secretary's regulations in the special zones. The report did not comment on the remainder of the broad suit provisions. As to the regulatory authority, the report stated: "We do not however, view such authority as setting a precedent for Federal Regulation of private lands adjacent to other parks in the absence of equally exceptional circumstances."[12/]

The report did not illuminate whether the amendment to the 1970 Act was intended to have transboundary effects, saying only:

> The proposed legislation also provides for an amendment to the General Authorities Act of 1970 to further define the Secretary of the Interior's duties and limitations with regard to the administration of the National Park System. This provision provides that the protection, management and administration of the various areas of the system, as previously defined, must be consistent with those high purposes originally established by Congress with the creation of the National Park Service in 1916. While this standard of decisionmaking should be self evident, we feel that the continued pressure upon the National Park System today makes a restatement and reenforcement of these basic premises very appropriate. 13/

11/ *Id.* at 27.

12/ *Id.* at 33.

13/ *Id.*

When the legislation was considered on the floor, an amendment in the nature of a substitute became the focus of the debate. Congressman Philip Burton, a sponsor and member of the Committee on Interior and Insular Affairs, noted that the provisions for regulatory authority had been deleted in the substitute:

> More particularly, if the members of the committee will recall, the subcommittee bill carried a provision for regulatory authority, which I thought was justified given the circumstances. *Along with that regulatory authority went certain injunctive authority for the Attorney General and other collateral legal tools.* The Senate, in facing this matter, decided that the potential risk of the precedent perhaps outweighed the justification of this proposal. So, the Senate, in adopting the same basic 48,000-acre design that the House developed -- that was also the design of the administration -- substituted for the regulatory authority certain abilities of the Secretary to acquire land in a 30,000 acre park protection zone, and as a result then *dropped the variety of legal tools that the House committee recommended* in its bill.
>
> It appeared to me that this compromise achieved essentially the protection of the Redwood Creek Basin . . . . Because we can achieve an equivalent result, I thought it wise to accept the Senate views, with a refinement, in that respect. 14/

It is interesting to note that in his remarks, Rep. Burton linked the authorization of injunctive suits with the authority of the Secretary to have promulgated regulations controlling uses on private lands within the designated

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14/ 124 Cong. Rec. 2910 (1978) (emphasis added).

zones, even though the language was not so limited and the provision amending the 1970 Act was retained. The Congressman's remarks may imply, therefore, that an ability to enjoin activities on private lands is not intended to be conferred by the 1970 Act amendment language. On the other hand, perhaps his remarks referred only to that part of the injunction language that was related to the regulatory authority, and were not addressed to the rest of the language; language that perhaps was seen as merely restating the existing authority of the Secretary.

The remainder of the House debate did not return to these issues.

The Senate version, S. 1976, was introduced on August 1, 1977 by Senator Cranston. As introduced, the Senate bill also initially reflected the suggestions of the Department of Interior.

In setting out the original administration-suggested provisions affecting private lands, Sen. Cranston said:

> Furthermore, the bill enhances the authority of the Secretary to protect the resource value of Redwood National Park by authorizing him to carry out a land rehabilitation program on lands upstream and adjacent to the park. Contracts or cooperative agreements would be authorized to initiate, develop, and implement such a program on lands contributing significant sedimentation because of past land use practices and to reduce risk of further damage to streamside areas adjacent to Redwood Creek. The Secretary is also authorized to establish zones where regulations are needed to protect the park resources from activities and interference occurring on non-Federal lands, and to enforce reasonable timber harvesting, land rehabilitation, and management practices where the existing State of California regulations are found insufficient to achieve the necessary protection. Secretary Andrus, in his transmittal letter to the Congress, noted in this regard that these steps were considered necessary because of the extraordinarily fragile ecology of the Redwood Creek watershed, particu-

> larly the Tall Trees Grove. The Secretary further noted, however, that this grant of authority would not be viewed as establishing a precedent for Federal regulation of private lands adjacent to other parks in the absence of equally exceptional circumstances. 15/

The Committee on Energy and Natural Resources, to whom the bill was referred, deleted the provisions on the regulatory zones, and injunctions, but retained the language amending the 1970 Act. The committee report notes that the regulatory authority was a "new approach" and that authority for the Secretary to acquire additional lands in a critical zone if harmful uses were occurring would better solve the problem. However, the Committee report also seemed to indicate that the reiteration of the high value of National Park lands contained in the amendment to the 1970 Act could serve as a basis for judicial intervention in uses of private lands detrimental to parks:

> It is the sense of the committee that there will be a continuing need to protect the expanded Redwood National Park from actions on private lands located within the same ecological units as the park.
>
> In part this need can be met by the exercise of the authorities provided by existing section 3(e) of the 1968 Act. The Committee intends that the authorities provided therein will be exercised as necessary to protect the park.
>
> In part, this need can also be met by the initiation of legal action against activities that threaten the park . . . .

15/ 123 Cong. Rec. 25847 (1977).

> In this regard, the committee strongly endorses the Administration's proposed amendment to the Act of August 18, 1970, concerning the management of the National Park System, to *refocus* and insure that the basis for decisionmaking concerning the System continues to be the criteria provided by 16 U.S.C. § 1 -- that is . . . [report quotes 1c] This restatement of these highest principles of management *is also intended to serve as the basis for any judicial resolution of competing private and public values and interests in the areas surrounding Redwood National Park and other areas of the National Park System.*
>
> The committee recognizes, however, that neither section 3(e) nor legal action have been totally successful in protecting park resources. It also recognizes that Secretary Andrus has strongly testified that the acquisition of the additional 48,000 acres will not, by itself, protect these expanded park resources. The administration proposed a standby regulation approach to this problem. It is the sense of this Committee that the situation at Redwood National Park is one where a standby acquisition, or protection, zone is more appropriate.
>
> The regulation concept is recognized to be a new approach to these adjacent land type problems for National Park Service areas. We believe the problems at Redwood National Park are too urgent to place reliance on such a new concept.
>
> Accordingly, the committee has deleted the regulation provisions of S. 1976 and, in lieu thereof, has substituted a "Park Protection Zone" 16/

In the section-by-section analysis of the report, it again is noted that the committee deleted the provisions requested by the administration for standby regulatory authority in favor of standby acquisition authority as set forth in the explanation on committee amendment 2.

16/ Sen. Report No. 528, 95th Cong., 1st Sess. 7-8 (1977) (emphasis added).

In discussing the amendment to the Act of 1970, the report indicates that the committee was concerned that:

> Litigation with regard to Redwood National Park and other areas of the system may have blurred the responsibilities articulated by the 1916 Act creating the National Park Service.
>
> Accordingly, this provision suggested by the administration would appear to be particularly appropriate. The Secretary is to afford the highest standard of protection and care to the natural resources within Redwood National Park and the National Park System. No decision shall compromise these resource values except as Congress may have specifically provided. 17/

In explaining the committee's deletion of the regulatory authority and the addition of new acquisition authority, Sen. Abourezk stated: "I believe the Secretary possesses sufficient authority to protect our national parks under current law. I urge the Secretary to use the acquisition authority in the park protection zone judiciously. If retained in the final bill, I would say the content is clear that the authority given is not a regulatory club, but rather a last resort to prevent physical damage to park resources." 18/

This explanation is somewhat contradictory in that if the current law provides sufficient authority for the Secretary to protect our national parks by somehow abating harmful actions on private lands, it is difficult to see why the power to condemn those lands was necessary. Or, if condemnation authority was necessary because it was not the policy of the federal government

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17/ Id. at 14.

18/ 124 Cong. Rec. 1563 (1978).

to control uses of private lands, then it is difficult to understand in what way current law, lacking as it does specific management directives, is sufficient to protect the parks. The floor discussions do not shed further light on the understanding of how current authority and the new language amending the 1970 Act related to the Secretary's ability to protect the parks from activities on private lands outside park boundaries.

The conference report provides no additional clarification.[19/]

On balance, although the issue is not free from ambiguity, it appears the 1978 Amendment of the 1970 Act was intended to clarify that the values and purposes for which the NPS System was established were intended to provide the basis for their management and protection, including protection from external threats. This was undoubtedly implicit in the 1916 and 1970 acts. Therefore, when Congress reiterated that the "high public value" of these lands should guide all activities associated with their management and protection, Congress arguably was attempting to prod the Secretary into more vigorous action. The references in the legislative history to the adequacy of current law and to the indications of "blurred responsibility" revealed by the Redwood National Park (RNP) litigation (discussed below) appear to indicate that the intent may have been to precipitate more suits to protect the parks from harmful outside activities. This interpretation is quite harmonious with the deletion of the express authority for the Secretary to directly regulate private lands outside the

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[19/] H.R. Report 931, 95th Cong., 2d Sess. (1978).

parks and to sue for enforcement of such regulation. Congress could have considered the indirect control of private land use through judicial injunction of harmful practices much more acceptable in that in the latter situation the federal government would be acting much as any other landowner. Given the reluctance of the Department to pursue such actions in the past, one may question the adequacy of the spare and general language chosen. However, the sufficiency of the language is an issue separate from its intent.

In the litigation surrounding the RNP that was referenced in the legislative history of the 1978 Act, environmental groups had filed suit to compel the Secretary to take action to protect the Park from harmful logging activities on nearby lands. In three stages of the same case, the federal district court for the northern district of California found the Secretary's performance of his duties to manage the NPS to be judicially reviewable,[20/] that he had failed to carry out those duties,[21/] but that ultimately he had complied with the order of the court to do so.[22/]

In its discussion of the three stages of the litigation that preceded the 1978 legislation, the Interior memorandum makes several statements as to the reasoning and conclusions reached by the court that do not appear warranted from the cases.

20/ Sierra Club v. Department of the Interior, 376 F. Supp. 90 (N.D. Cal. 1974).

21/ 398 F. Supp. 284 (N.D. Cal. 1975).

22/ 424 F. Supp. 172 (N.D. Cal. 1976).

The Interior memorandum at 14-15 correctly notes that in case I, the court cited both the National Park Service Organic Act of 1916 and the RNP Act as empowering the Secretary to protect the Park, but focused on the RNP Act to discern specifically enforceable duties. At trial in the second case, the memorandum at 15 states that "while once again citing both the Organic Act and the RNP Act in support of its general conclusion, the court's order setting forth the specific 'reasonable steps' that the Secretary might be obliged to take within a reasonable time to acquit his statutory responsibilities included only those actions identified in the 'unique' Redwood park enabling legislation . . . ." Yet the court's opinion makes it clear that the Secretary should exercise all powers vested in him by law, and particularly those detailed in the RNP Act; and that he should perform all the duties imposed by law including in particular those specific ones set out in the RNP Act[23/] -- a very different emphasis. Perhaps the court was merely indicating, and properly so, that it would not speculate as to the precise nature of the actions the Secretary might be obligated to take under the general statute if the Secretary also had failed to carry out specifically enumerated statutory duties.

Similarly, the Interior memorandum at 16 indicates that in stating that the Secretary might seek clarification of the situation from Congress, the court had "implicitly acknowledged that additional Congressional action would be necessary before the Secretary would be empowered to do anything to that end not specified in the Redwood legislation." As to the third case, the memorandum states at 16 that because the Secretary "had neither

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[23/] 398 F. Supp. at 293 (emphasis added).

funds *nor authority* to take the other actions proposed by the court in its second opinion -- the court purged the Secretary of his previously found failure . . . . Thus it would seem clear that the Redwood cases did not support the notion that the Organic Act endows the Secretary with extensive extra-territorial jurisdiction which would allow him to protect NPS units from threats originating on lands without them. To the contrary, the clear implication of these cases is that the Secretary's extra-territorial power is limited to that expressly identified by Congress." (Emphasis added.)

This conclusion does not necessarily follow from a reading of the cases in question, which in fact indicate the contrary. At the time of the second case, the Secretary was supported by the general park management authorities and the specifics of the RNP Act, which at that time authorized him to modify the boundaries of the Park and negotiate agreements with the logging companies. Neither of the latter efforts was productive, in part because of lack of effort by the Secretary and in part because of lack of funds. No actions had been taken to attempt to carry out the *general* duties of the Secretary. By the time of the third case, it was quite clear that the Secretary had attempted to reach agreements with the timber companies and that those efforts had failed because the companies had not cooperated. It was also clear, however, that the Secretary had undertaken other measures that could only be under his general authorities to accomplish park purposes in general and those of the RNP in particular. The Secretary had, for example, recommended alternative courses of action that required additional funding, which OMB had declined to request, and which therefore the Secretary could not implement. Interior also indicated it requested new additional regulatory power over peripheral timber operations to solve the problem of the logging activities without additional federal monies.[24] There is a significant difference between requesting legislation because one lacks authority altogether and requesting legislation because one lacks the funds to carry out existing authority. The third case also indicates that Interior had by that time recommended to the Justice Department that litigation be instituted to restrain peripheral timber practices which imminently endanger the Park, a recommendation that was "under consideration."[25] There was no elaboration as to the nature of the suits recommended, but since the Secretary had so few specific powers under the RNP Act, it appears reasonable to assume that such suits would be based on his more general management and protection duties under either the RNP Act or the 1916 and 1970 Acts. In either case, the Secretary was not returning to Congress because he was powerless to act at all under current authorities, but rather because certain of the actions he by then sought to pursue were stymied for other reasons, e.g., that litigation on behalf of the Department is conducted through the Justice Department, which may or may not proceed.

Therefore, it is not clear that the Redwood cases do not support the notion that the Organic Act endows the Secretary with some extra-territorial jurisdiction. That power may not be "extensive", but the cases do not indicate that it is limited to that expressly identified by Congress. While the Secretary may not have authority to zone and directly regulate private lands uses of which are harmful to parks, he does appear to have both the duty and the power to seek judicial intervention to abate such uses.

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[24] 424 F. Supp. at 174.

[25] *Id.*

The Interior memorandum does correctly note that another district court has found the Secretary's duty to be quite clear and that that duty could require the assertion of federal rights in judicial proceedings -- for example, by bringing trespass or nuisance actions if appropriate.[26/] Whether these common law causes of action would be available for relief from air pollution originating outside the parks is discussed in the following section.

Common Law

The Department of the Interior memorandum appropriately concludes that "substantial doubt exists as to the availability of federal or state common law actions . . . as a means to protect NPS units from the adverse effects of air pollution generated outside those units." The memorandum also notes that different principles apply to application of federal common law as opposed to state common law. The argument that federal common law cannot apply is strong; applicability of state common law is more open to dispute.

The Supreme Court's decisions in City of Milwaukee v. Illinois ("Milwaukee II")[27/] and Middlesex County Sewerage Authority v. National Sea Clammers Association[28/] stand for the broad proposition that there is no room for application of federal common law to supplement remedies authorized by a comprehensive federal

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[26/] 487 F. Supp. 443 (D.D.C. 1980).

[27/] 451 U.S. 304 (1981).

[28/] 453 U.S. 1 (1981).

statutory scheme of regulation. The Supreme Court's rationale was that ordinarily "it is for Congress, not federal courts, to articulate the appropriate standards to be applied as a matter of federal law."[29] The question is whether Congress through the statute has addressed a problem, not whether the particular regulatory controls applied by the administering agency are deemed by the court to be adequate. There can be little question that the PSD controls in the CAA address the problem of air quality in national parks in a manner that defeats the argument that an "interstice" exists to be filled by federal common law.[30] If, as *Sea Clammers* suggests, all that is required is that Congress has addressed "the area of [air] pollution" comprehensively, then the same conclusion would be drawn.[31] *Milwaukee II* has been applied to hold that the CAA is so comprehensive as to preempt federal common law remedies.[32]

While there is a presumption that federal statutory law *does* preempt federal *common* law, the presumption is that federal law *does not* preempt state statutory or common law. As the Court in *Milwaukee II* expressed it, the starting point for determining whether state law has been supplanted by federal law is "the assumption that the historic police powers of the States were not to be superseded . . . unless that was the clear and manifest purpose of Congress."[33]

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[29] Milwaukee II, 451 U.S. at 317.

[30] See *Milwaukee II*, 451 U.S. at 324-25 n. 18 (district court in applying federal common law "was not 'filling a gap' in the regulatory scheme, it was simply providing a different regulatory scheme").

[31] See 453 U.S. at 22.

[32] See United States v. Kin-Buc, Inc., 532 F. Supp. 699 (D.N.J. 1982).

[33] 451 U.S. at 316.

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Although case law is sparse, there may be reasons for not applying the presumption against preemption of state law in the context of the Secretary of the Interior's authority to protect national parks. One reason is that the rationale for the presumption may be inapposite. The question here is whether protection of federal land by federal officials falls within the purview of the "historic police powers of the States" protected by the presumption. This is a moot point. It is also arguable that application of state law to *instate* pollution (some air pollution affecting national parks has crossed state boundaries; some has not) may be preempted by federal law under rationales developed in the federal common law cases. Finally, there is a related argument that even if the air pollution in question is intrastate in origin, the federal interest in protecting the parks is such that a federal rather than a state rule of law should apply.

Support for these arguments that federal rather than state law should apply can be found in a decision of a federal district court in *United States v. Outboard Marine Corp.*,[34] dismissing a claim by the United States based on the state common law of products liability. The United States claimed that its sovereign interest in the nation's navigable waterways was injured by a PCB manufacturer's failure to warn purchasers of the dangers of spills into waterways. The district court determined that "a suit by the United States to protect navigable waterways from pollution requires a federal rule of decisions under *Milwaukee I* [*Illinois v. Milwaukee*, 406 U.S. 91 (1972)] and a statutory rule of decision under Milwaukee II."[35] When the Supreme Court authorized Illinois to pursue federal common law remedies in Milwaukee I, it cited both the nature of the action (water pollution) and the character of the parties. The district court in Outboard Marine reasoned that, while some water pollution cases might not require a federal rule of decision, "the federal interest is at its strongest [when] the United States is suing to protect its sovereign interest in the nation's waterways."[36] Similarly, it might be argued that a federal rule of decision should be required when the United States is suing to protect its interest in public lands from air pollution.

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[34] 549 F. Supp. 1032 (N.D. Ill. 1982).

There are several countervailing arguments relating to preemption of state law remedies. First, it can be argued that the United States, when acting as a property owner, should not be denied any remedies available to other property owners within a state. If property owners are permitted under state law to maintain nuisance or other common law actions to abate air pollution not controlled by federal or state air pollution regulation, then the United States should also have this right. Secondly, there is the question of the Clean Air Act's relationship to the Park protection authorities noted above, viz., does the Clean Air Act limit the general statutory authority to protect national parks from external threats?

That the United States may sue in state courts under state law to protect its property is a well-established principle. See, e.g., Cotton v. United States,[37] holding that the United States could bring a trespass action in state court for damages against someone who had unlawfully cut and removed timber from public land. More recently, but before Milwaukee II, a federal district court held that this proprietary right of the United States to sue to protect its property was not eliminated by the Clean Air Act.[38] The district court relied on the general principle that statutes will not be held to divest the sovereign of existing rights and remedies unless there is a clear expression or indication of intent to do so. A contrary intent, to preserve federal remedies, was found in CAA § 310, which provides that the Act "shall not be construed as superseding or limiting the authorities and responsibilities, under any other provision of law . . . of . . . any other Federal officer." While this case did not distinguish between federal and state common law, it is arguable that its rationale is still valid as applied to federal utilization of state law remedies.

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[35] Id. at 1034-1035.

[36] Id. at 1034.

[37] 52 U.S. (11 How.) 232 (1850).

As discussed above, the general park protection authorities have been interpreted as including the discretion to bring "trespass or nuisance actions if appropriate."[39] It is arguable that application of Milwaukee II principles to the air pollution context would not affect whatever authority exists to utilize state common law trespass and nuisance actions as a means of exercising this broad authority to protect the parks. Looked at in this light, the issue is whether the Clean Air Act circumscribes the general park protection authority in the field of air pollution, and not whether strictly common law remedies have been preempted.

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[38] United States v. Atlantic-Richfield Co., 478 F. Supp. 1215 (D. Mont. 1979).

[39] Sierra Club v. Andrus, 487 F. Supp. 443, 448 (D.D.C. 1980).

Because park protection language was strengthened in 1978, the 1977 Clean Air Act Amendments, containing the PSD protections for parks in Part C, cannot be said to have repealed by implication the 1978 changes. Any such argument would have to establish that the 1977 CAA repealed by implication the then-existing park protection authority (to the extent that it might go beyond PSD regulation), and that the 1978 amendments, although general, did not change the status quo with respect to air pollution. Repeals by implication are disfavored, CAA Part C is silent as to relationship to other federal laws, and CAA § 310, *supra*, suggests that other federal remedies are preserved. Nonetheless, there must be some doubt as to whether the very general park protection authority may be invoked to extend regulation beyond what is permitted by Part C, a regulatory scheme addressing the specific problem of damage to public lands by air pollution. There is a possible analogy to *Sea Clammers*, *supra*, where the Court closed the door tightly not just on federal common law actions, but also on the alternative remedies sought under the civil rights laws (42 U.S.C. § 1983) and under the theory of implied rights of action.

If application of state law is not precluded by the nature of the action (by application of *Milwaukee I* and *Outboard Marine* principles) and if no "clear and manifest" congressional purpose to preempt can be found, there would still be the question of whether state law (common or statutory) would permit imposition of controls stricter than those required by the Clean Air Act. And there is the additional question of whether a state would permit common-law remedies to supplement remedies available under its air pollution control statute. What rule individual states would apply in these situations is beyond the scope of this analysis.[40/]

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[40/] Committee staff have informed us that air pollution problems exist in NPS units located in at least four states. Staff has asked that we determine whether state common-law remedies for air pollution appear to be preserved in those states in the face of state statutory programs dealing with air pollution, with particular reference to claims of the Department of the Interior.

All four states have included in their air pollution statutes a savings clause that seems to preserve common-law remedies. Cal. Health & Safety Code § 41509(d); Me. Rev. Stat. Ann. tit. 38, § 581; Tenn. Code Ann. § 68-25-114; Wash. Rev. Code Ann. § 70.94.370. The cited provisions appear in each case to reach common-law actions brought by federal agencies. See Cal. Health & Safety Code § 39047(e); Me. Rev. Stat. Ann. tit. 38, § 582.9; Wash. Rev. Code Ann. § 70.94.030(3). Thus, whatever common-law rights are afforded the Department of the Interior in these states would appear unimpaired by state statutory efforts to control air pollution.